

# END

ELECTRONIC NONSENSE FOR ENGINEERS AND ENGINEERING MANAGERS

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Joly



It's a sad fact that engineering schools give short shrift to the social graces. Yet, in your career, you're faced with the necessity of dealing with people, many of them highfalutin. This column, therefore, will give you the rudiments of etiquette, both to spare you embarrassment and to increase the likelihood of your keeping your job. This month, we'll explore how to act in a fancy restaurant.

1. Upon entering, show no signs of being impressed. Statements like, "Gosh, this is a beautiful, fancy place" are a no-no. Just raise your eyelids slightly and say something like, "Hmm—looks as though my decorator's been here."

2. Always carry a flashlight and a pair of scissors with you. Americans think dark restaurants are classy, so it's likely you won't be able to read the menu by the light of the small candle on the table. Using the scissors, cut out the price column from the menu. That way, the person you're with won't think you're price conscious. And never ask for a translation of items printed in French. Nod your head knowingly and order at random.

3. When you taste the wine the sommelier (wine steward)

brings, chew it a while, then spit it on the floor. Then, even though you have no idea how good or bad the wine is, say something like, "Hmm—an impish little wine" or "Hmm—it has an imposing character that stops just short of ostentation."

4. When you eat your meal, be ambidextrous. Switching the fork from hand to hand after cutting your meat reveals your roots.

5. Finally, if your waiter's name is Jacques or Pierre, impress him and your dining companion by using a little French. Here are three phrases that are sure to go over big.

★ *Cette nourriture est abominable.*

(set new-ree-tyur ett ah-bow-me-nah-bluh)

This food is delicious.

★ *Je pense que je vais vomir.*

(zhe ponss kuh zhe vay voh-meer)

I think that I will return.

★ *Votre chef est un sacré imbécile.*

(voe-truh chef ett uhnh sah-crav em-bay-seal)

Your chef is a real genius.

## ENGINEERS YOU HAVE DEFINITELY WON A FREE GIFT!!!

### **Gift Category A**

The Taj Mahal  
Yankee Stadium  
Fort Knox  
47k, 1% Resistor

### **Gift Category B**

19" Color TV  
Food Processor  
Pasta Machine  
47k, 5% Resistor

### **Gift Category C**

Tooth Brush  
HB Pencil  
Pocket Protector  
47k, 20% Resistor

Inspect the three numbers below. If no numbers match, you've won a gift from Category C! If two numbers match, your gift is in Category B! If all three numbers match, you'll definitely receive one of the gifts in Category A!!!

**6347**

**6347**

**6347**

To claim your gift, all you have to do is visit our engineers' vacation resort in beautiful Sleazonia, West Virginial! You'll receive a presentation (whether you want it or not) on the benefits of purchasing a lifetime privilege to spend your vacations in our luxurious 4×6-ft mobile dwellings, which feature convenient outdoor toilet facilities and a test lab nearby.

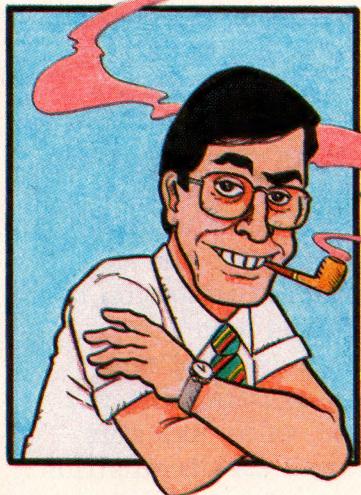
Before setting up an appointment, simply find the gold star somewhere in this magazine and paste it on the entry certificate found somewhere else in the magazine. Then find the blue dot somewhere, and paste it on the gold star. To be eligible for the grand prizes, find the symbols of the Taj Mahal, Yankee Stadium, and Fort Knox somewhere in the magazine, and paste the symbol of your choice on the Grand Prize form found somewhere else. Then, stand on your head for 30 seconds while reciting "Beautiful Sleazonia." Finally, send proof that you're married with a combined income exceeding \$80,000 and a copy of your mortgage, including all liens attached thereto, to

Sleazonia Vacation Resorts Inc  
1500 Sucker Lane  
Sleazonia, WV 55555

Drawing for Grand Prizes will take place June 6, 1989. Drawing will be supervised by Joe. Odds of winning: Taj Mahal, Yankee Stadium, Fort Knox: 1 in 1 googolplex. 19" Color TV, Food Processor, Pasta Machine: 1 in 1 googol. Tooth Brush, HB Pencil, Vinyl Pocket Protector: who cares?

# EDITORIAL

## Tax the watt guzzlers and bit polluters



President Bush has inherited the excruciatingly difficult task of reducing our country's \$17 zillion deficit. His "1000 points of light" can only increase the debt—how much depends on the wattage of the lights. A plausible way to cut the deficit is to tax electronics end users who use circuits and systems that consume too much power, operate too fast, or use too many bits.

It's inarguable that our deficit is linked closely to our consumption of energy. Because we have 432 ready-to-go nuclear plants whose startups are blocked by picketers who yearn for a return to kerosene lamps, we must use fossil fuels to produce electricity, Ovshinsky notwithstanding. And because OPEC is poised to inflict another '70s-type punishment on us, we simply must reduce the power we consume. Some will say, "What's the problem? Now we have CMOS, so power consumption is going down." True. But what most people don't realize is that our supply of C is dwindling rapidly. There's still plenty of N in the hills, but NMOS has fallen out of favor. So we must import a high percentage of the C we use in making CMOS ICs—hardly a way to reduce the deficit.

The ever-increasing speed of modern systems is inextricably tied to the rising consumption of power. What's needed, then, is a tax system that penalizes excessive power consumption and its bosom buddy, high speed. I propose that President Bush issue guidelines on IC speed. For example, he could impose a limit on A/D-converter speed in the form of a maximum resolution-frequency product. In my opinion, 315 CM (codes × MHz) is a reasonable figure. A 12-bit A/D converter, for instance, has 4096 codes. The 315-CM limit would restrict the converter's speed to 0.077 MHz, corresponding to a conversion time of 13 μsec.

Another factor tied to power consumption is bit count. The evolution of computer systems from 8 to 16 to 32 bits has been accompanied by significant increases in power consumption. The same is true for the ever-increasing RAM capacities in modern computers. A side effect of this insatiable demand for more and more bits is bit pollution. A large portion of these zillions of bits goes unused, and so we have the problem of bit disposal and its resulting pollution. Land bitfills are becoming exhausted; bit incinerators use fossil fuels and pollute the atmosphere.

A presidential commission could determine a reasonable progressive tax on the number of bits in a system. Another source of revenue would be a tax on bit disposal. This disincentive would provide an impetus for developing trinary (base-3), quadrary (base-4) and quinary (Schweppes) computers, which use fewer bits to process a given amount of data. Some other ways to reduce the deficit:

- Sell Silicon Valley to the highest bidder
- Raise engineers' income taxes to 90% of gross income
- Eliminate all taxes on management personnel. Management deserves the credit for the healthy state of American electronics, despite engineers' blunders; eliminating taxes on these business geniuses will provide incentive for making companies healthier yet.
- Impose an application fee of \$1,000,000 per patent
- Restrict defense contractors' illegal overcharging to 20% of a contract's face value (unless the illegal overcharging is proven to be justified).

*WJ Travis*

Bill Travis  
Contributing Editor

# NEWS BREAKS

## COMPANY MARKETS DATA-DEGRADATION SYSTEM

A new data-acquisition board, dubbed "BarfData," is available from Data Distortion Inc (Chesterfield, MA), a company that specializes in PC-based analog-signal degradation. The board features 16 poorly multiplexed analog-input channels, a signal-degrading instrumentation amplifier, a track-and-hold distorting amplifier, and a 12-bit, nonlinear A/D converter. The input multiplexers are from the bottom of the barrel, and offer only 20-dB channel-to-channel isolation and 1 MΩ each of on- and off-resistance. By the time a signal reaches the instrumentation amp, it's tainted by pollution from adjacent channels and severely attenuated by the multiplexers' high on-resistance. The instrumentation amp's specs are as repugnant as the multiplexers'; for example, gain accuracy is  $\pm 48\%$  and total harmonic distortion is -15 dB. The almost unrecognizable signal then goes to the track-and-hold amp, whose abominable pedestal, accuracy, and droop parameters introduce additional errors in the signal. Finally, the output A/D converter features nauseating differential and integral nonlinearity and misses at least 2011 of its 4096 codes. Explains Joe Signalicide, president of Data Distortion, "Any wimp can make a data-acquisition system whose output accurately represents the input codes; it's a real art form to take a perfectly pure input and turn it into a stench in the nostrils of the signal-processing community."—Bill Travis

## EVERYBODY ACQUIRES EVERYBODY

In a startling press conference on April 1, a spokesman from Insiders Inc, a Wall Street illegal-insider-information trader, announced that every electronics firm in the US has concluded a leveraged buyout of every other firm. According to Insiders' Boesan Ivesky, top-secret negotiations for the buyouts have been going on for the past three years. The ramifications of the buyouts are unclear at this moment; what's certain, however, is that every firm plans to fire every other firm's management team. The implications for design engineers in the acquir(ed)(ing) companies are equally unclear. Ivesky revealed, however, that the industry plans to adopt a free-agent system similar to the one used in professional sports.—Bill Travis

## IBM ANNOUNCES PS/1,000,000 SERIES

Big Blue set the computer industry on its ear on April 1, when the firm announced its new, PS/1,000,000 Series of personal computers. Designed to prevent cloning, the family uses a bus architecture called TeraChannel—a 128-bit bus structure that's covered by 967 patents, 401 copyrights, and two Emmy awards. Additional clone-thwarting measures include explosive cabinet bolts, an automatic videotape record of users, and a 1-time user oath (with Bible) administered by the firm's authorized value-depleted resellers (VDRs). According to Mr Large Blue of IBM, Microhard is developing a PS/1,000,000-compatible operating system called OS/1,000,000. Immediately after IBM announced the series, a consortium of personal-computer manufacturers (led by Compaq) revealed plans for a counterattack. The firms plan to introduce a 256-bit, open-architecture system that uses Intel's new 8,000,986 microprocessor, a 250-GHz IC that addresses 9,999,999,999,999,999 Tbytes of memory.

—Bill Travis

# DEAR ABBOTT

## Avoid burned-out ICs . . . also, how much for trade secrets?

Dear Abbott:

I have this problem with CMOS logic ICs. Every time I wire up a breadboard, I end up with one or more burned-out ICs. I've tried fusing the power supply and bringing the voltage up gradually, but nothing seems to help. Do you have any idea what I'm doing wrong?

Worried, Santa Clara, CA

Dear Santa:

Sure—you're not seasoning the CMOS ICs properly. It's a little-known fact that these circuits require some "stroking" before you can use them in an application. The procedure is simple: Wear shoes with leather soles and scuff them about 20 times on a nylon rug. Then run a nylon comb through your hair about 10 times. Now you're ready to season the ICs. Just hold one row of pins against a ground plane and touch the other row (the row with the input pins) with your index finger. You should have no more problems.

Dear Abbott:

I'm bewildered. First, we had the 150V supplies for powering vacuum-tube circuits. Then  $\pm 15V$  came along, and it seemed to be the ultimate solution. Now we have ICs that are powered from single 5V supplies, and some say the voltage will drop even further, say to 3.3V. What's your opinion about all these changes? Concerned in New Jersey



Dear New:

Well, let's look at it from the standpoint of numerology. Consider the ratios of the successive power-supply voltage-span reductions—150V to 30V, a ratio of 5; 30V to 5V, a ratio of 6. Now hold on to

your hat. What's startling is that the ratio of 5V to 3.3V is 1.5151515 . . . , a never-ending number. Are you sitting down? There's more—it so happens that Ramus II, the father of astrological proctology, was born on May 6, 1515. If I were you, I'd run right out and play 5615 in the daily-numbers lottery.

Dear Abbott:

My boss and I have this argument going. We have an application for a large number of extremely fast flip-flops. I want to use an ECL gate array, and my boss is set on using a GaAs array. Who do you

think is right? ECL Advocate, High Power, CA

Dear ECL:

You're both wrong. The 6SN7 dual triode makes the best flip-flop in the world. You and your boss have the same problem: You're hung up on the latest, trendiest technology, and you've lost sight of tried-and-proven techniques. Get off the fad bandwagon and take some time to smell the filaments.

Dear Abbott:

I'm a circuit-design engineer in a defense-electronics firm, and I don't make enough money to make ends meet. The problem is, my wife likes Porsches, Perrier water, and expensive yuppie restaurants. So, I've begun selling some of our company's schematics to a bearded man named Boris. My question is, how do I determine how much to charge? Entrepreneur, Profit Motive, CA

Dear Entrepreneur:

First, let's determine my share for not turning you in. I think 40% is equitable. The best way to set a price for stolen trade secrets is to charge by the IC count. That way, you'll have an incentive to maximize the number of ICs in the circuits you design. I feel \$1000 per IC package (\$10,000 for gate arrays) is fair. You'll receive the number for my Swiss bank account in the mail.

*Dear Abbott is pleased to answer questions from engineers who are either too dumb or too lazy to solve their own problems. Send self-addressed stamped envelope and a blank, signed check.*

# Use a negative capacitor for useful, banal applications

Bill Travis, *Contributing Editor*

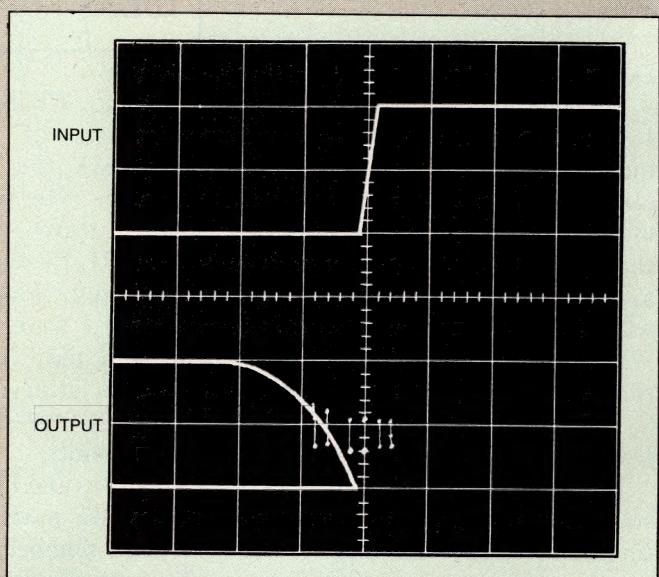
It's been 21 years since this editor, employed as a bizarre-product development engineer at Sprague Electric Co (North Adams, MA), serendipitously invented the MinusCap (**Ref 1**). This component resembles an ordinary capacitor in every way, except that its value is negative (for example,  $-1 \mu\text{F}$ ). **Fig 1** shows the startling results of applying a step signal to a series-RC integrator incorporating the MinusCap. Note that the output waveform has a negative time constant. This phenomenon is easy to explain—to preserve the negative exponent of  $e$  in the expression  $V_{\text{out}} = V_{\text{in}}(1 - e^{-t/\tau_{\text{RC}}})$ , the time  $t$  assumes a negative value.

An interesting aspect of the output waveform in **Fig 1** is the fact that two output voltages exist simultaneously. A useful, albeit banal, application comes to mind. If you connect a lowpass and highpass dc-voltage filter to the output and buffer the outputs of the filters, you obtain a dual-voltage power supply. For example, assume the lower output voltage in **Fig 1** is 5V and the upper one is 15V. A 5V lowpass dc filter with reasonably steep skirts will, for all intents and purposes, completely attenuate the 15V signal and pass the 5V level. And vice-versa for the 15V highpass dc filter.

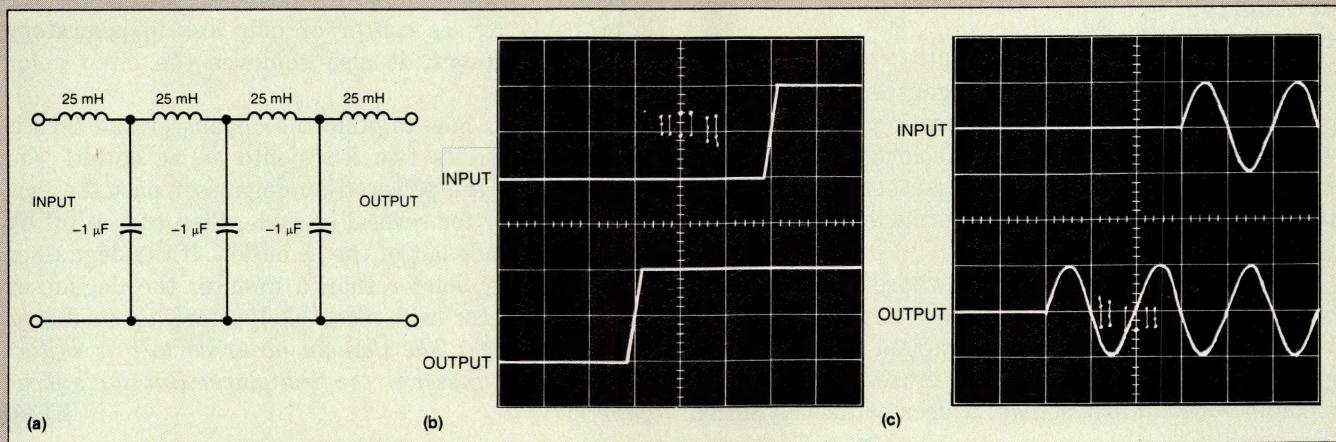
Some applications suggested in **Ref 1** include predictions of future noise spikes, scope probes with zero shunt capacitance (made by connecting an equal-value

MinusCap in parallel with the probe's positive capacitance), and observations of future failures. The promise of a rosy future for the component, however, never bore fruit. The Department of Defense (DoD) seized all lab samples and notes, and put the material in the same storage facility that's housed the Lost Ark (**Ref 2**) since 1939.

Because of the USSR's development this year of the negative inductor and the imaginary resistor, the DoD



**Fig 1—**This scope photo depicts the input and output waveforms of the  $-1 \mu\text{F}$  MinusCap; pay no attention to the phospher burn marks.



**Fig 2—It's up to you to figure out any useful applications for the MinusCap.**

no longer considers the MinusCap to be a threat to national security. Development of paper, ceramic, and electrolytic negative capacitors is now underway at several manufacturers' facilities. At the mammoth EDN test lab, for example, this editor recently constructed some units that exhibit a  $-1\text{-}\mu\text{F}$  value and effective series resistance of  $-0.1\Omega$ .

Fig 2a shows a delay line constructed with 25-mH positive inductors and the  $-1\text{-}\mu\text{F}$  MinusCaps. In Fig 2b, you see the results of applying a 10V step to the input of the line. The output step appears 3 msec before the application of the input. As seen in Fig 2c, the same results accrue when you apply a sinusoidal input to the input of the delay line (actually, the anticipation line)—the sinusoidal output appears at the output 3 msec before the application of the input. It's up to you to determine useful applications for such anticipation lines. One possibility is to detect changes in system logic states before they occur.

One final application possibility, one the DoD is studying very carefully, is in imaginary-frequency transmitters. The expression

$$f = \frac{1}{2\pi\sqrt{LC}}$$

gives the frequency determined by an LC tank in an oscillator. If the value of C in the expression is negative, then the resulting frequency is, naturally,

$$f = -j \frac{1}{2\pi\sqrt{L|C|}}.$$

The reason for the DoD's interest in such imaginary-frequency transmitters is the fact that their signals are detectable only by imaginary receivers, such as those the DoD often receives under defense contracts.

EDN

## References

1. Travis, W J, "The negative capacitor: A challenging new component," *EEE*, September 1968.
2. Jones, Indiana, "Discovery of the Lost Ark of the Covenant," *Journal of Mythical Artifacts*, July 1939.

## CAREER OPPORTUNITY: ENGINEERING PROFESSORS NEEDED

If you're experienced in electronic engineering but you feel you're at a dead end in your job, consider making a career change. At Real-World Engineering Institute, we have openings for professors who can teach practical courses not offered at most engineering schools. Some examples:

- Buck-Passing I and II. The fundamentals of how to avoid taking the blame for project catastrophes. Includes such categories as The Power-Outage Ploy, Copy-Protection Crash, and Joe Did It.
- Advanced Rationalization. The course material gives students hundreds of ways to explain away undesirable results in their designs. Some topics: We Need a Class-(1000/100/10/1) Clean Room, We're Getting Lousy Wafers from Our Supplier, and The Coprocessor Made a Math Error.
- Climbing the Ladder. How designers can stab their bosses in the back and get ahead. Examples: Anonymous Notes to the President, Anonymous Notes to the Boss's Wife, and The Perfect Murder.

Back-stabbing, scapegoating, and buck-passing experience is preferred. Send your resume in complete confidence to:

**Real-World Engineering Institute  
Opportunism, CA**

An equal-opportunity employer.

# ABERRANT DESIGN IDEAS

## Gausser/degausser brightens color monitors

Ted Burton  
*Signetics*

A small permanent magnet (the gausser), held in close proximity to the face of an operating color monitor, will produce a striking display of colorful patterns (Fig 1). Much to the chagrin of the gausser user, though, the colorful patterns turn into permanent color clouds when the gausser is removed.

Luckily for the gausser user, whose job might now be in jeopardy, it's easy to build a degausser from a 1000-ft roll of 30-gauge wire-wrapped wire. This degausser is not UL approved, it erases any magnetic medium within a foot or two, it uses potentially lethal

voltages, it interferes with pacemaker operation, and it probably causes cancer or hair loss in laboratory rodents. However, it also removes the cited color clouds.

Fig 2 shows how to build the degausser and turn it on by sticking its two leads into an ac outlet. You should sweep the powered-up degausser past the face of the monitor for several seconds, then turn it off by pulling the leads out of the ac outlet. If the degausser is left running longer than a minute, the degausser and its operator will most likely start to smoke or burn. (*Ed Note: The thought occurred to this editor: Why use the gausser in the first place? But that's pica-yune.*)

EDN

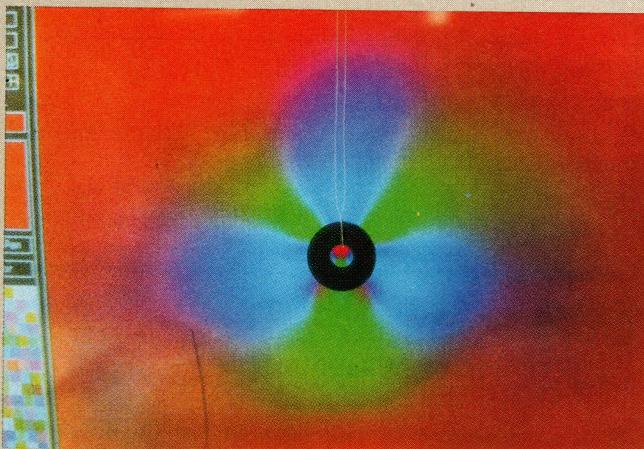


Fig 1—A simple magnet can really liven up your color monitor.

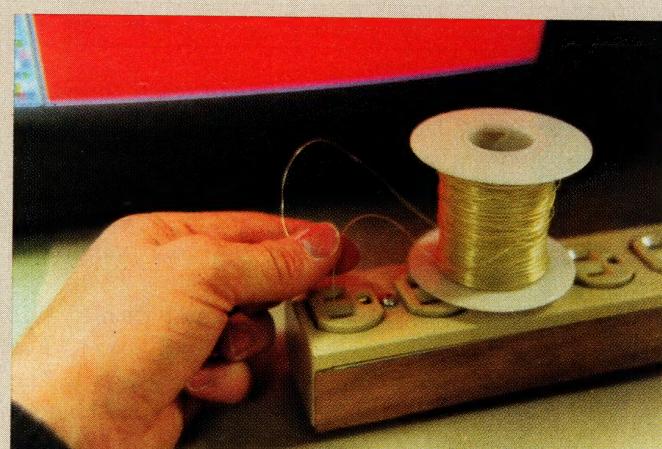


Fig 2—In addition to killing innocent lab animals, this degausser gets rid of the colorful patterns on your monitor.

## Exploit Z80's hidden logarithmic mode

Jim Williams  
*Linear Technology Corp*

The popular Z80 microprocessor contains a very powerful embedded routine dedicated to high-speed logarithmic functions. Because it operates in real time, it is significantly faster than lookup tables or computational approaches. Furthermore, it's directly addressable in analog format. All Z80 chips have this capability, although manufacturers do not supply the necessary data to exploit it.

The circuit in Fig 1 is a complete, real-time logarithmic ratio computer that uses fully parallel, coprocessing Z80s in the embedded logarithmic mode. Connecting an analyzer between the Z80's ground pin (pin

29) and the D<sub>1</sub> data bus (pin 15) reveals the internal logarithmic instruction set. Figs 2a, 2b, 2c, and 2d show that the best performance occurs in the 300-nA to 750-μA range.

This designer (*Ed Note: We must avoid writing in the first person at all costs*), discoverer of the Z80's logarithmic mode, is ebullient. Everyone always told this designer that analog circuits were nowhere. Now this designer believes it. Microcomputers are great. You can do anything with them. Can you imagine what's possible with one of those 32-bit babies? This designer will bet that you can get another decade with

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The quality of components is what makes boards, units of equipment and whole systems reliable.

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CIRCLE NO 54



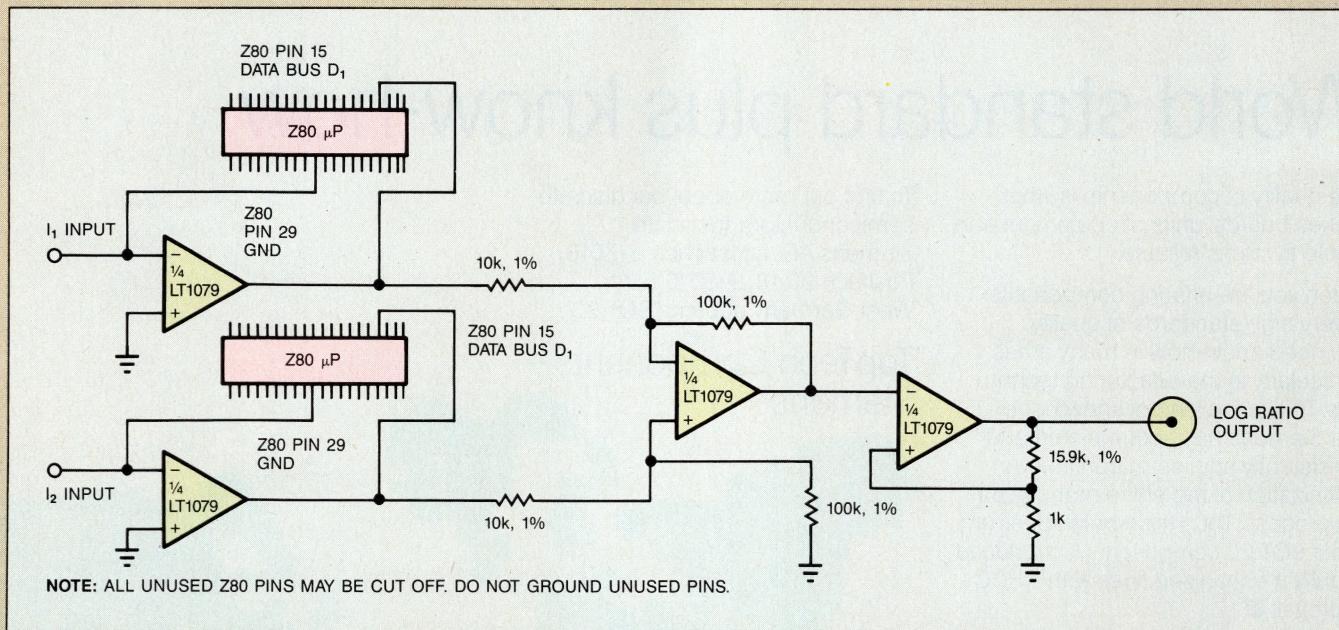
A 19100-B-Z016-X-7600

# ABERRANT DESIGN IDEAS

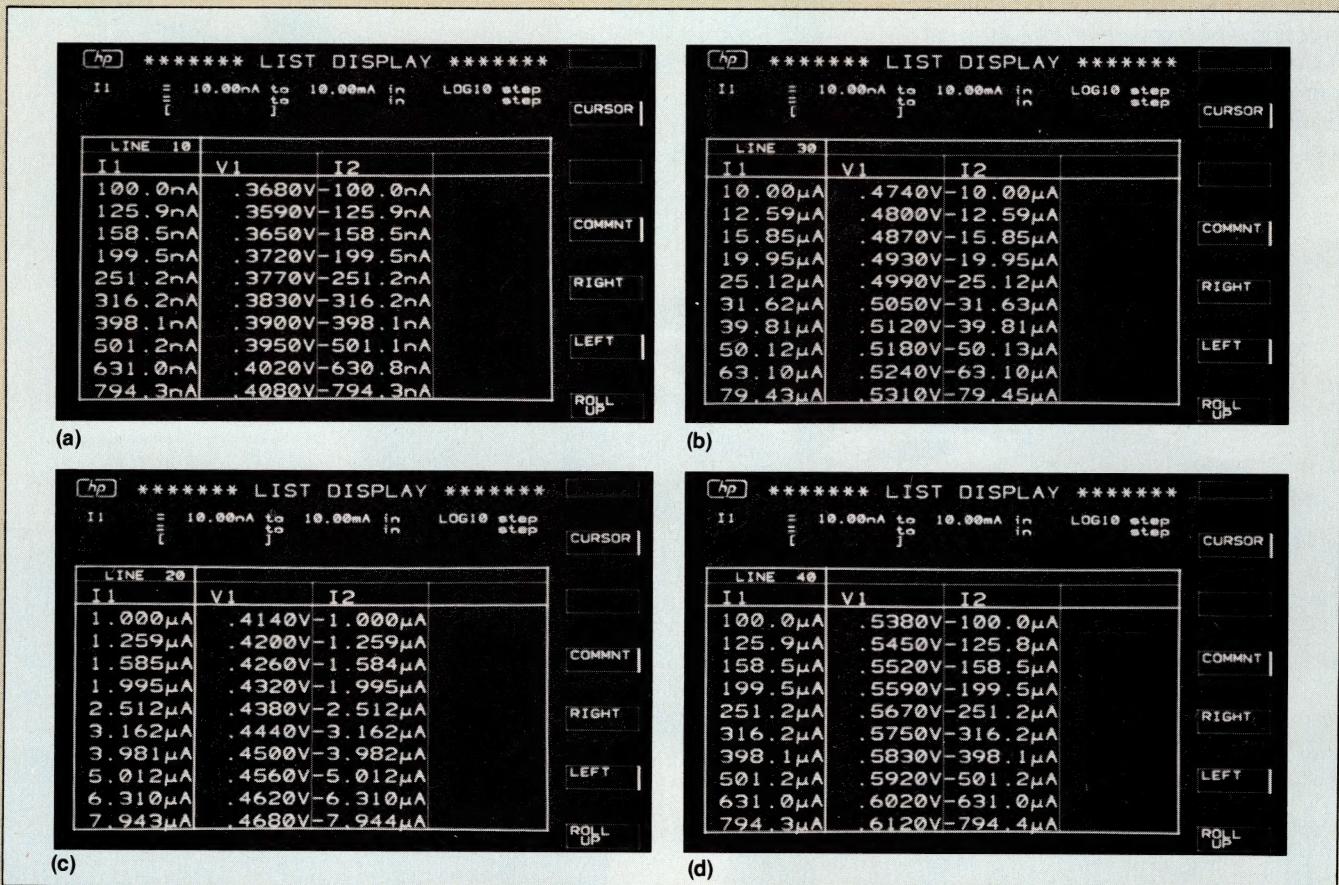
that 386 thing. After lunch, this designer is going to go over to Intel and apply for a job. This designer is also going to trade in his Tektronix 547 and 556 for a

development system. But it's going to be tough to find one with those funny little dots on the CRT.

**EDN**



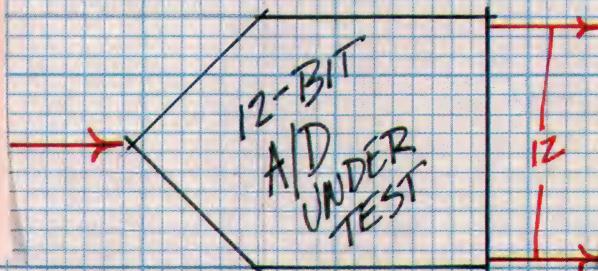
**Fig 1—A couple of Z80s, configured as full parallel coprocessors, perform real-time logarithmic ratio computations.**



**Fig 2—After viewing these displays, this author now believes "microcomputers are great."**

# 1 is impossible. 2 is undesirable. 3 is...

SUPER  
LINEAR  
RAMP



ARRAY  
PROCESSOR

TEST TIME

$$\frac{4096 \text{ CODES} \times 100 \text{ POINTS/CODE} \times 20 \text{ USEC/POINT}}{8.192 \text{ SECONDS}}$$

PROBLEM:

SPEED UP  
THE 8-SECOND  
LINEARITY TEST

OPTIONS:

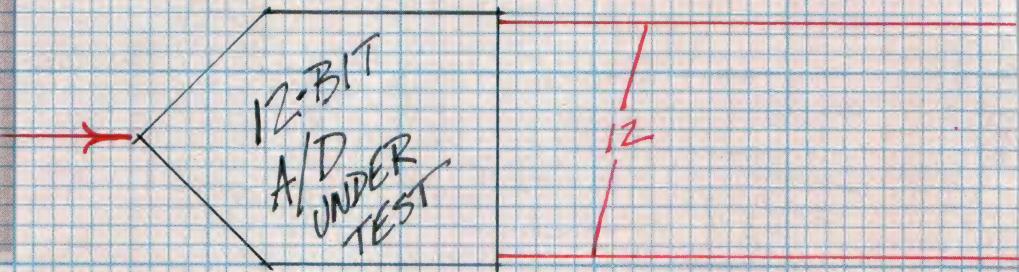
- 1: SPEED UP THE DEVICE
- 2: COMPROMISE TEST QUALITY
- 3: SPEED UP THE TESTER

The choices don't appear to be very attractive, but the problem must be solved. An eight-second test time for all-code differential and integral non-linearity testing is out of the question for production testing. And it gets worse geometrically for higher-order converters: A 16-bit device would take 128 seconds.

What about your options? The A/D already spits out numbers ten times as fast as most testers can process them — especially with the single, general-purpose array processor typically used for this test. Testing less codes or reducing the amount of averaging would seriously diminish test quality.

Which leaves you with speeding up the tester. An option LTX has considered...

SUPER  
LINEAR  
RAMP



HIGH THROUGHPUT TEST TIME

$$4096 \text{ CODES} \times 100 \text{ POINTS/CODE} / 10 \times 20 \mu\text{SEC} = 819 \text{ ms}$$

PROBLEM  
SOLVED

Hi.T, the high-throughput tester from LTX, gets a tenfold speed boost through a new technique: a local Digital Signal Accelerator that reads the A/D's output directly and does the bulk of the calculation on the fly. Which leaves the downstream array processor to compute results on one tenth the original data — in one tenth the time of other testers.

# *...unbeatable. As long as it's Hi.T.*



As a result, the Hi.T system brings all-code test time down to just 800 milliseconds. So you no longer have to compromise full testing to meet production demands on A/Ds and other sophisticated mixed-technology devices.

The Digital Signal Accelerator system is just one of the many local computers Hi.T uses to remove testing bottlenecks. Local processing helps Hi.T's parallel analog resources perform instant DC measurements. And local processing throughout the

## **Hi.T. High-throughput linear testing from LTX.**

system cuts down the time it takes instruments to set up between tests.

The result: Hi.T, as you would expect, approaches testing speed limited only by the response time of the device itself. When you're looking for speed — in multiples — Hi.T is the obvious choice.

Get "Beat the Clock," our White Paper with the details on Hi.T's Digital Signal Accelerator. Circle the number or call Carol Everett at (617) 461-1000.

**LTX** *Responds.*

CIRCLE NO 60

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can design, prototype,  
build and  
ship cable  
assemblies  
to my specs."**

From concept  
to completion:  
3M delivers

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application-specific  
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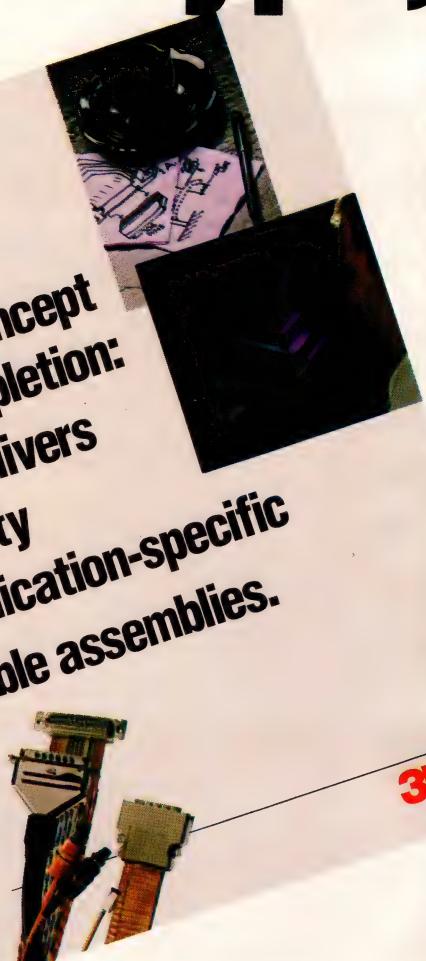
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**3M**

# NEW PRODUCTS

## COMPUTERS & PERIPHERALS

### THERMAL PRINTER

- Contains NiCd battery pack for handheld applications
- Unit measures  $4.5 \times 2.6 \times 6.2$ -in. and weighs 2.25 lbs

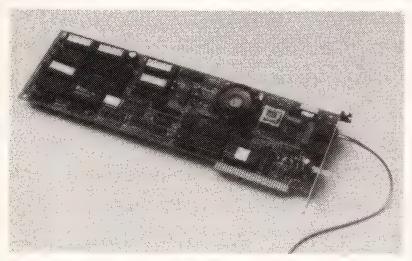
The SP-400B is a battery-powered handheld thermal printer useful in field applications requiring a portable data logger. The unit has a 40-column thermal printhead, an enclosed paper supply, and a replaceable NiCd battery pack. It can print as many as 3000 lines of text between battery charges and contains a multinational character set with graphics capability. The unit provides three input interfaces: an RS232C serial port, a 20-mA current loop, and a Centronics parallel port. The printer comes in an aluminum case measuring  $4.5 \times 2.6 \times 6.2$ -in. and weighs only 2.25 lbs. A flip-



open cover permits easy access to the paper supply and battery pack. \$435. Delivery, four to six weeks ARO.

Syntest Corp., 40 Locke Dr, Marlboro, MA 01752. Phone (617) 481-7827. FAX 617-481-5769.

Circle No 370



### SNA COMM BOARD

- Conforms to CCITT V.32
- Combines three communications protocols on one plug-in board

The AdaptModem V.32 is a multi-protocol communications board for the IBM PC, PC/XT, PC/AT, PS/2 models 25 and 30, and compatible computers. Because the board is designed for IBM's Systems Network Architecture (SNA), it implements three communications protocols on one plug-in board: a full-duplex asynchronous modem and a synchronous modem, which conform to the CCITT V.32 standard, and a Synchronous Data-Link Control adapter. The board also supports 9600-bps communications for a vari-

ety of available AdaptSNA software packages for SNA communications protocols, including interactive 3270, batch 3770/RJE, cooperative processing LU6.2/APPC, and program-to-program LU0. Plug-in board, \$1295; AdaptSNA software packages, \$245 to \$785.

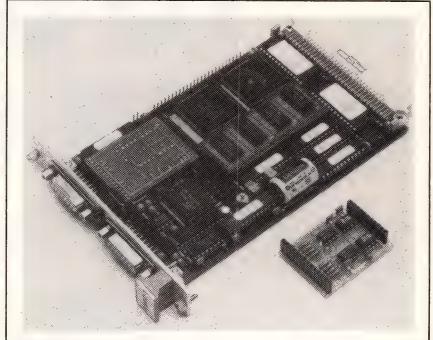
Network Software Associates Inc., 22982 Mill Creek, Laguna Hills, CA 92653. Phone (714) 768-4013.

Circle No 371

### BOARD COMPUTER

- Has a CMOS  $\mu$ P and peripheral devices
- Is housed on a single-height VME bus board

Implemented with CMOS devices, the VSBC-1 single-board computer for VME bus systems consumes only 3W of power. The single-height board has a 68HC000  $\mu$ P that runs at a clock speed of 12.5 or 16.7 MHz, and a memory capacity of 1M bytes of zero-wait-state



CMOS static RAM and as much as 512k bytes of 1-wait-state EPROM. I/O facilities include two serial ports that you can configure with piggy-back modules to operate at RS-232C, -422, -485 levels or in a 20-mA current loop mode, and a 16-bit parallel port with additional handshaking lines. You can optionally have a SCSI bus interface that is controlled by an NCR53C90 SCSI bus controller. Other onboard peripherals include 16- and 24-bit timer/counters, a real-time clock, and a watchdog timer. An onboard lithium cell provides battery backup for the real-time clock and static RAM.

## COMPUTERS & PERIPHERALS

The board's VME bus interface includes a 7-level interrupt handler and a single-level bus arbiter. Software support includes the OS-9 and PDOS operating systems, and debug monitor firmware. From \$590 in OEM quantities.

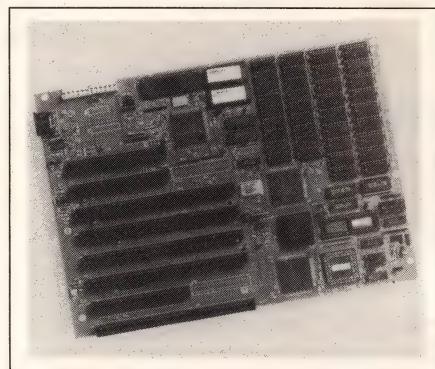
**Pep Modular Computers GmbH,**  
Am Klosterwald 4, 8950

Kaufbeuren, West Germany. Phone (08341) 81001. TLX 541233. FAX 08341-40422.

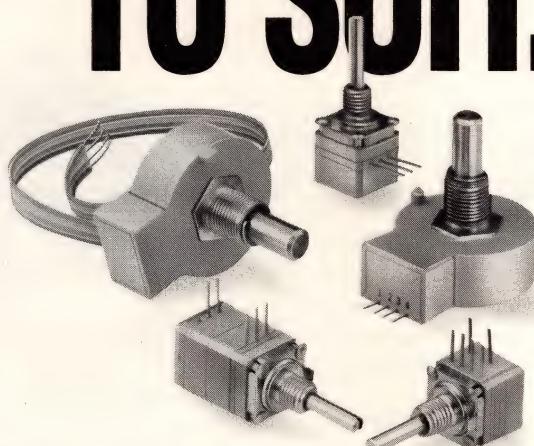
**Circle No 372**

**Pep Modular Computers Inc,**  
600 N Bell Ave, Carnegie, PA  
15106. Phone (412) 279-6661. FAX  
412-279-6860.

**Circle No 373**



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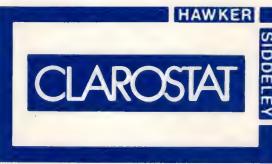
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**1-800-872-0042.**

## WHY WAIT?



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**CIRCLE NO 62**

### 386SX MOTHERBOARD

- Contains as much as 4M bytes of zero-wait-state RAM
- Comes with RAM utilities that include disk caching

The Bullet-386SX motherboard features a 16-MHz 80386SX µP and is available with 512k, 1024k, or 4096k bytes of dynamic RAM running with zero-wait-states. It also contains five IBM PC/AT compatible expansion slots as well as three IBM PC/XT compatible expansion slots. The motherboard's dimensions conform to the IBM PC/XT motherboard form factor. It comes with a RAM utility package that includes disk caching, RAM disk, print spooling, and support for the EMS LIM 4.0 memory extension. It also has a socket for an optional 16-MHz 80387SX coprocessor. The board comes with a limited 2-year warranty. A motherboard with 512k bytes of DRAM and a 4-utility package costs \$823, which includes a 50% discount for resellers on the first unit.

**Wave Mate Inc**, 2341 205th St, Suite 110, Torrance, CA 90501. Phone (213) 533-8190. FAX 213-533-5940.

**Circle No 374**

### PGA VERIFIER

- Tests LCA designs for the IBM PC/AT
- Consists of a plug-in card, a pod, and a target-system probe

The Mesa I in-circuit PGA development tool for Xilinx's Logic Cell Arrays (LCA) consists of an IBM PC/



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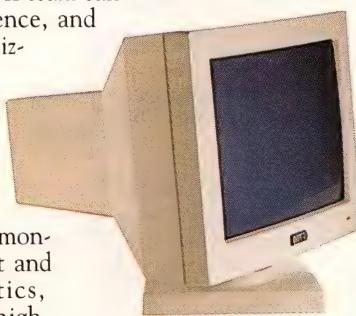
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CIRCLE NO 48

AT-compatible plug-in card, a pod with 12 LCAs, and a probe with an LCA connector and socket for the target system. The tool lets you verify host-downloaded data, observe the register states in the target LCA, isolate signals from the target system and create states to isolate problems, and alter real-

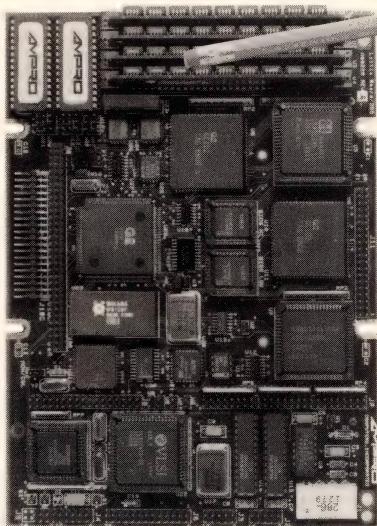
time designs. In addition, the unit serves as a breadboard for developing LCA designs. A shadow LCA acts as a mirror for the states in the target LCA. The company and Tektronix jointly developed a flex-circuit cable that connects the pod to the probe. The probe connector plugs into a PLCC socket on the

target system. The Mesa I software, which runs under Windows, is compatible with Xilinx's design software, allowing it to extract symbolic information from XACT files. \$9390. Delivery, eight weeks ARO.

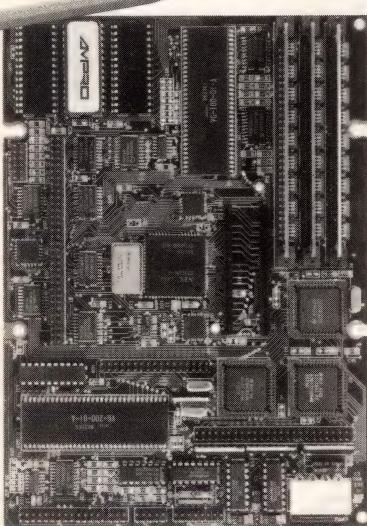
**Data I/O Corp**, Box 97046, Redmond, WA 98073. Phone (206) 881-6444. TLX 152167. FAX 206-882-1043.

Circle No 375

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### STD I/O CARDS

- Provide 16 optoisolated inputs and outputs
- Each output can switch 50V with 400-mA max load current

The 242-1 and the 342C-1 dual-port optoisolated I/O cards for the STD Bus provide 16 input and 16 output circuits arranged as two 8-bit ports. The 242-1 is compatible with the STD TTL Bus, and the 342C-1 is compatible with the STD CMOS Bus. You can configure the inputs to handle standard TTL inputs by setting an input threshold voltage to 1.4V. In addition, the inputs can handle industrial voltage swings by setting the threshold to 6.4V above industrial ground. The input circuits can withstand input voltages between -50 to +50V. The output circuits have Darlington open-collector arrangements with provisions to install pullup resistors. Each output can switch 50V at 400 mA max. Each of the two input and two output ports has its own power supply on board, which requires only a 5V signal from the bus. 242-1, \$438; 342C-1, \$486 (10).

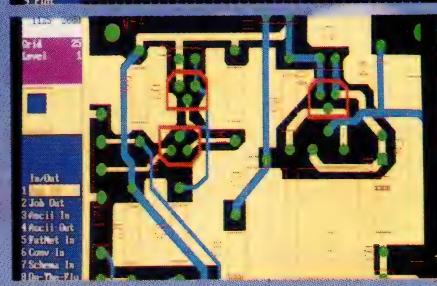
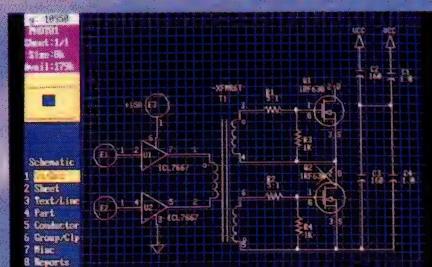
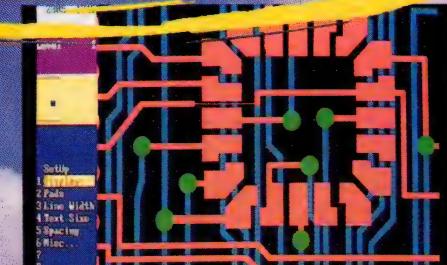
**Enlode Inc**, 1726 Kingsley Ave, Orange Park, FL 32073. Phone (800) 874-7729; in FL, (904) 264-4405. FAX 904-264-0765. TLX 466036.

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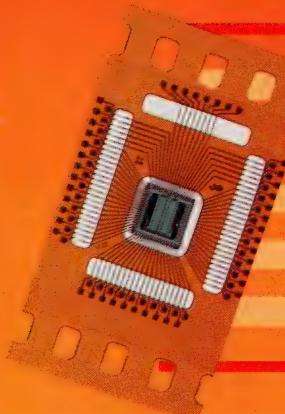
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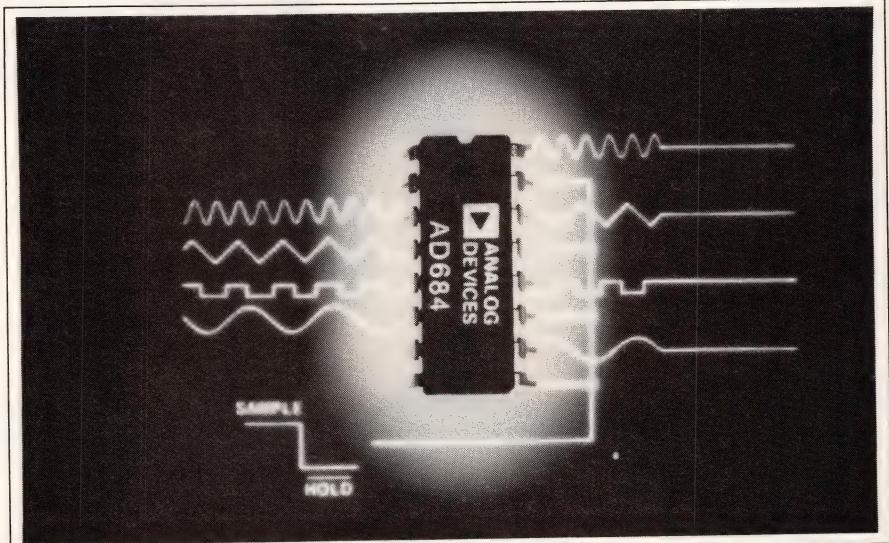
# NEW PRODUCTS

## INTEGRATED CIRCUITS

### QUAD S/H AMPLIFIER

- Has 12-bit accuracy
- Acquisition time is 600 nsec

The AD684 quad S/H amplifier features 12-bit accuracy and a sampling rate to 100k samples/sec. Each channel of the AD684 has a guaranteed maximum acquisition time of 600 nsec to within 0.1%, and 1  $\mu$ sec to within 0.01% for a 10V step. For simultaneous sampling, the AD684's entire error budget is completely encompassed in a 300-psec max aperture offset between channels. A proprietary error-correcting architecture compensates for hold-mode errors and ensures 12-bit accuracy and repeatability. The AD684 has a maximum full-scale nonlinearity of 0.005%, and its hold characteristics include a 500-nsec maximum settling time, 200-

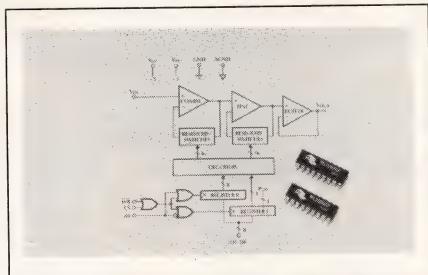


psec aperture uncertainty, and a 10-nsec aperture delay. The IC operates from  $\pm 12$ V supplies and dissipates 530 mW max. Three temperature grades are available. From

\$23.50 (100).

**Analog Devices**, Literature Center, 70 Shawmut Rd, Canton, MA 02021. Phone (508) 935-5565

Circle No 351



### LOG GAIN/ATTENUATORS

- Provide control from -24 to 24 dB
  - Interface with 8- and 16-bit buses
- The ML2008 and ML2009 amplify or attenuate analog signals to  $\pm 3$ V under  $\mu$ P control and are noise-rated at 900 nV/ $\sqrt{\text{Hz}}$  at 1 kHz. The devices provide automatic signal-level control from -24 to 24 dB in 0.1 dB steps. The ML2008 interfaces to an 8-bit  $\mu$ P bus, using two write operations to store nine gain-setting bits and a power-down bit. The ML2009 has a single 9-bit data register, which you can program with one write operation when using a 16-bit data bus. Both devices operate from  $\pm 5$ V supplies. 18-pin

DIP or 20-pin plastic chip carrier, \$5.50 (100).

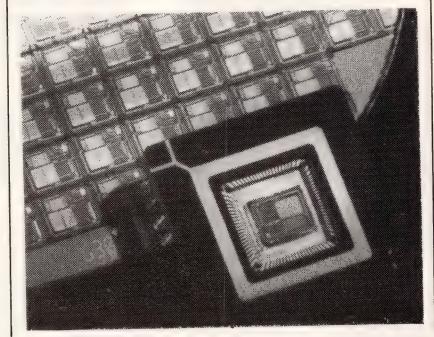
**Micro Linear Corp.**, 2092 Concourse Dr, San Jose, CA 95131. Phone (408) 433-5200.

Circle No 352

### VIDEO CONTROLLER

- Features video rates to 120 MHz
- Supports high-resolution graphics

The IMS-G300 video controller supports high-resolution color graphics applications with resolutions of  $640 \times 480$  (VGA),  $1024 \times 768$ , and  $1280 \times 1024$  pixels. The highly integrated chip contains a  $256 \times 24$ -bit color look-up table, a programmable video-timing generator, a 32-bit multiplexed pixel port, a triple video DAC with 8-bit resolution, and an on-chip, phase-locked loop. The -G300 can handle video rates to 120 MHz and interlaced or noninterlaced video. The chip has four 8-bit pixel ports, which accept data



directly from the video RAM array at 25% of the video rate. The pixel port has two software-selectable operating modes. Mode 1 sends the data via the 24-bit color look-up table, permitting the selection of 256 colors from a choice of over 16 million. Mode 2 sends the 24-bit data directly to the 8-bit video DACs, allowing the display of 16 million colors at any one time. The devices come in 84-pin PGA or LCCC packages. An 85-MHz part, \$100 (1000).

**Inmos Corp.**, Box 16000, Colorado Springs, CO 80935. Phone (719) 630-4215.

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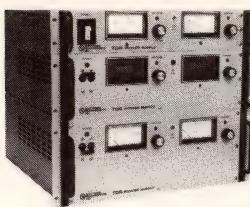
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- CV/CC with automatic crossover
- Fully programmable and remote sense
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- 5-year warranty



### THREE PHASE TCR

- 3 power ranges 2,500 W - 5,000 W - 10,000 W
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- Regulated and metered (V and A)
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405 Essex Rd., Neptune, NJ 07753, Dept. EM  
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CIRCLE NO 44

## INTEGRATED CIRCUITS

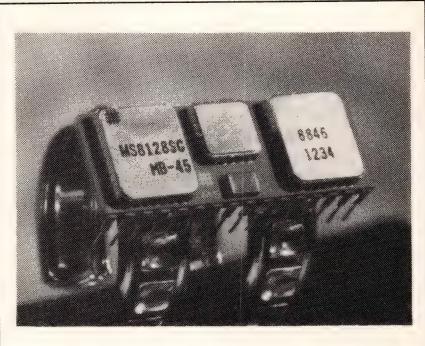
### DUAL AUDIO DAC

- Features 20-bit resolution
- Has two independent channels

The D20200 is a complete, dual, 20-bit, D/A-converter subsystem. The module includes two 20-bit DACs, a stable bipolar reference, a serial CMOS/TTL-compatible digital interface, and two distortion-suppressing output deglitchers/amplifiers. It needs no external components or trimming to meet its specifications; you only need to connect  $\pm 15$  and 5V power supplies, a serial data source, and appropriate timing signals. The D20200 handles output signal amplitudes from 0 to -60 dB. Total harmonic distortion and noise is typically -90 dB at -20-dB output and -52 dB at -60-dB output. Differential nonlinearity is typically  $\pm 0.0002\%$  of FSR. The D20200's serial interface accepts digital word lengths from 16 to 32 bits, and it accepts simultaneous or multiplexed data at a 15-MHz maximum clock rate. It converts at rates from dc to 200 kHz per channel and accepts digital coding formats of two's-complement, offset binary, or complementary offset binary. \$199 (100).

**UltraAnalog Inc.**, Box 14164, Fremont, CA 94539. Phone (415) 657-2227.

Circle No 354



ramic leadless chip carriers that are bonded to a single 32-pin ceramic DIP substrate that also carries chip-select decoding logic and power-supply decoupling capacitors. Operating at a clock frequency of 1 MHz it consumes 150 mW of power from one 5V supply; in standby mode, it consumes 2 mW. A low-power version, which consumes only 40  $\mu$ W in standby mode, is available for applications that use battery backup. From £145 to £290 (100).

**Hybrid Memory Products Ltd.**, Elm Rd, W Chirton Industrial Estate, N Shields, Tyne and Wear NE29 8SE, UK. Phone 091-258-0690. TLX 53206. FAX 091-259-0997.

Circle No 355

**Mosaic Semiconductor Inc.**, 7420 Carroll Rd, Suite 200, San Diego, CA 92121. Phone (619) 271-4565. FAX 619-271-6058.

Circle No 356

### STATIC RAM

- Features access time as low as 55 nsec
- Operates over the military temperature range

Targeted for use in military and aerospace applications, the MS-8128SC 128k  $\times$  8-bit high-speed static RAM has an operating temperature range of -55 to +125°C and can be screened to MIL-STD-883C requirements. It is available with access times of 55, 70, 85, 100, 120, or 150 nsec and has TTL-compatible inputs and outputs. The device is manufactured from four 32k  $\times$  8-bit RAMs packaged in ce-

### ANALOG MULTIPLEXERS

- 100 $\Omega$  on-resistance
- 250 nsec switching times

Pin compatible with the industry-standard DG508A and DG509A, the DG408 and DG409 analog multiplexers offer improved specifications compared to earlier types. The on-resistance of the DG408/409 is only 100 $\Omega$ , leakage current is less than 0.5 nA, switching time is 250 nsec, and power dissipation is only 2.5 mW. The DG408 is an 8-channel, single-ended device with a 3-bit binary address. The DG409 is a 4-channel, differential device with a

# INTEGRATED CIRCUITS

2-bit binary address. In addition to specification improvements, the DG408 and DG409 feature reduced sensitivity to electrostatic discharge (ESD) and the ability to withstand  $\pm 400\text{V}$  on all pins (with respect to ground). Both TTL-compatible multiplexers conduct current equally well in both direc-

tions and allow operation with supply voltages to  $\pm 15\text{V}$  or with 12 and 0V unipolar supplies. 16-pin DIP and small-outline packages, \$4.68 to \$15.92 (100).

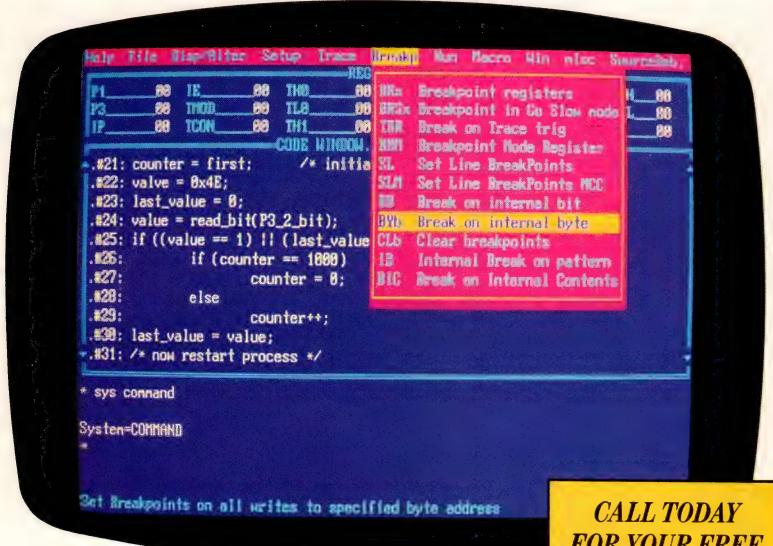
**Siliconix Inc**, 2201 Laurelwood Rd, Santa Clara, CA 95054. Phone (408) 988-8000.

Circle No 357

Electro/89  
Booth 0367

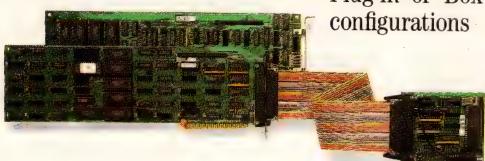
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Nohau's EMUL51-PC emulator and trace board make a sophisticated bug-hunting pair for your 8031/8051 projects. Plug the EMUL51-PC into your PC, XT, AT or compatible and find bugs that other emulators can't. Our powerful software makes it a snap to use.

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- Available in either "Plug-in" or "Box" configurations



The EMUL51-PC comes with a 5-ft. cable, software and 1 year hardware warranty with free software updates. Trace board optional.

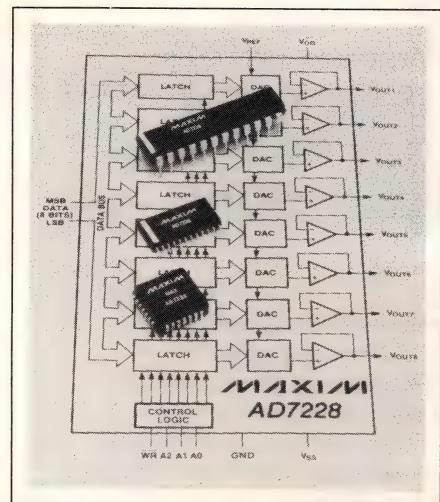
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**NOHAU**  
CORPORATION

51 E. Campbell Ave.  
Campbell CA 95008  
(408) 866-1820



### OCTAL 8-BIT DAC

- Includes output buffers
- Has  $\mu\text{P}$  interface logic

The AD7228 CMOS IC features eight fully independent 8-bit, voltage-output D/A converters with output buffer amplifiers in a 24-pin DIP, SO package, or plastic lead-chip carrier. The AD7228 requires no external trims or components to achieve full specified performance and guaranteed monotonicity with any of the standard 5, 12, or 15V supplies. Each of the eight DACs has an individual latch that accepts and holds data written by the system  $\mu\text{P}$ , similar to an address in system memory. Because the AD7228 works with a write-pulse width of 95 nsec, it is compatible with most  $\mu\text{Ps}$ . Each DAC can provide an output to 10V for a 2-k $\Omega$  and 100-pF load at a slew rate of 2 V/ $\mu\text{sec}$  and a settling time of 5  $\mu\text{sec}$ . The AD7228 is available in grades of  $\pm 1$  LSB and  $\pm 2$  LSB, and in three temperature ranges. \$32 to \$37.50 (100).

**Maxim Integrated Products**, 120 San Gabriel Dr, Sunnyvale, CA 94086. Phone (408) 737-7600.

Circle No 358

# SUPER FAST SRAM



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256K 25ns / 64K 15ns**

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| MT5C2561   | 256K X 1                       | 25ns    | PDIP, CDIP, SOJ, LCC |
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| MT5C2565   | 64K X 4 $\overline{\text{OE}}$ | 25ns    | PDIP, CDIP, SOJ, LCC |
| MT5C2568   | 32K X 8                        | 25ns    | PDIP, CDIP, SOJ, LCC |
| MT5C6401   | 64K X 1                        | 15ns    | PDIP, CDIP, SOJ      |
| MT5C6404   | 16K X 4                        | 15ns    | PDIP, CDIP, SOJ      |
| MT5C6405   | 16K X 4 $\overline{\text{OE}}$ | 15ns    | PDIP, CDIP, SOJ      |
| MT5C6406/7 | 16K X 4 S.I/O                  | 15ns    | PDIP, CDIP, SOJ      |
| MT5C6408   | 8K X 8                         | 15ns    | PDIP, CDIP, SOJ, LCC |
| MT5C1601   | 16K X 1                        | 15ns    | PDIP, CDIP, SOJ      |
| MT5C1604   | 4K X 4                         | 15ns    | PDIP, CDIP, SOJ      |
| MT5C1605   | 4K X 4 $\overline{\text{OE}}$  | 15ns    | PDIP, CDIP, SOJ      |
| MT5C1606/7 | 4K X 4 S.I/O                   | 15ns    | PDIP, CDIP, SOJ      |
| MT5C1608   | 2K X 8                         | 15ns    | PDIP, CDIP, SOJ      |

\*Slower speeds also available.

## MICRON

TECHNOLOGY, INC.

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# "A SINGLE AD IN EDN NEWS EDITION GENERATED AN INQUIRY LEADING TO A \$2 MILLION OPPORTUNITY!"

John Poturny, President  
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Fred Silver, Director of Marketing  
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Chatsworth, CA

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Advertising results. A publication must provide them.

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Both Silver and Poturny agree about the power of EDN News Edition, "it gets results."

John Poturny

Fred Silver



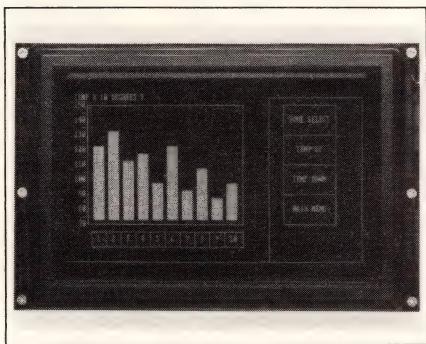
EDN News Edition works for marketing communication partners, Poturny & Associates and Rantec. It can work for you.

**EDN**

**Where Advertising Works**

# NEW PRODUCTS

## COMPONENTS & POWER SUPPLIES



### DISPLAY MODULE

- Features VT320 emulation
- Includes touch-input system

The M320ST electroluminescent display module provides graphics capability and VT320 emulation with standard 80-character × 25-line text. It also features an infrared touch-input system, SealTouch, that provides a resolution of 2000

touch points. SealTouch firmware allows you to program button sizes, positions, and response. You can have as many as 120 pages with a maximum of 120 buttons/pg. You can define buttons as pop-up menus, multistate responses, or program them for touch sensitivity for applications requiring fail-safe operation. Complete terminal setup parameters are accessible on screen. The module includes an RS-232C, RS-422, or RS-485 serial communications port (or optional 4- to 20-mA operation), a serial printer port, and an ASCII keyboard port. \$3195.

**Digital Electronics Corp.**, 31047 Genstar Rd, Hayward, CA 94544. Phone (415) 471-4700. TLX 172073.

Circle No 360

### FIBER-OPTIC LINK

- Operates over 2 km
- Offers user-selectable inputs

This fiber-optic link provides an RFI/EMI-secure circuit for Electrospace Systems' MLP-1 phone and its associated PBX. The link consists of the F9765 and the F9766 and has a transmission capability of 2 km min. The F9765 is designed for use at the PBX end of the circuit and includes a male 25-pin connector. The F9766 is located at the phone and features a female 25-position connector. The link has a 0.3- to 3.5-kHz bandwidth and outputs 0 dBm into a balanced 600Ω load. Each unit consists of two pc boards. The first board holds the power supply and the digitizing and multiplexing circuitry, and the sec-

## Digital filters

Manufactured by

**NPC**  
NIPPON PRECISION CIRCUITS LTD.

| DEVICE            | PACKAGE    |          | COMPOSITION              | SAMPLING FREQ.<br>OVER SAMPLING | TAPS                  | FILTER CHARACTERISTICS (dB)     |                           | DATA FORMAT        |                    | FEATURES  |
|-------------------|------------|----------|--------------------------|---------------------------------|-----------------------|---------------------------------|---------------------------|--------------------|--------------------|---|
|                   | TYPE       | PIN      |                          |                                 |                       | PASSBAND RIPPLE                 | STOPBAND ATTEN-<br>UATION | INPUT              | OUTPUT             |   |
| SM5803AP/<br>APT  | DIP        | 28       | 2 channels               | 8/4 times                       | 153+29+17             | ±0.00005                        | 110                       | Serial             | Serial             | For digital audio system                                      |
| SM5813AP/<br>APT  | DIP        | 28       | 2 channels               | 8 times                         | 153+29+17             | ±0.00005                        | 110                       | Serial             | Serial             | For digital audio system                                      |
| SM5802<br>A/B     | FPP        | 60       | 2 channels               | 2 times                         | 80                    | ±0.09±0.01                      | 90                        | Serial<br>Parallel | Serial<br>Parallel | High stopband attenuation<br>Small passband ripple            |
| SM5804<br>A/B/C/D | FPP        | 60       | 2 channels               | 4 times                         | 80 + 15               | ±0.09±0.015                     | 90                        | Serial<br>Parallel | Serial<br>Parallel | High stopband attenuation<br>Small passband ripple            |
| SM5805            | DIP        | 28       | 2 channels               | 2 times                         | 121                   | ±0.001                          | 90                        | Serial             | Serial             | For recording and playing                                     |
| SM5806            | DIP<br>SOP | 28       | 2 channels               | 2 times                         | 70                    | ±0.05                           | 60                        | Serial             | Parallel           | For compact disk  |
| SM5807<br>D/E/F   | DIP<br>SOP | 16       | 2 channels               | 4 times                         | 61 + 13               | ±0.05                           | 50/45                     | Serial             | Serial             | For compact disk  |
| SM5814<br>A/B     | DIP<br>SOP | 22<br>24 | 2 channels               | 4 times                         | 105 + 21              | ±0.001±0.01                     | 70/52                     | Serial             | Serial             | 64 steps digital attenuation<br>sharp cut-off characteristics |
| SM5820            | DIP        | 40       | 1 channel                | 52kHz<br>(max)                  | 60<br>(max)           | Mask Option                     |                           | Parallel           | Parallel           | Semi custom   |
| SM5831            | FPP        | 64       | 4 on-chip<br>multipliers | 15MHz                           | 4, 7, 8<br>cascadable | On-chip<br>coefficient register |                           | Parallel           | Parallel           | For video signal  |
|                   | PGA        | 68       |                          | 25MHz                           |                       |                                 |                           |                    |                    | High speed digital filter                                     |

U.S. and Canada Sales Office

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FAX: 408-922-0137



For complete product information and order,  
contact Jim Chang,  
Director of Customer Service/Developments  
or, Greg Branch, Sales Director

CIRCLE NO 39

## COMPONENTS & POWER SUPPLIES

ond holds the interface circuitry. A slide switch allows you to select link inputs of 115 or 230V ac, 47 to 63 Hz. The link operates over 0 to 50°C and consumes 6W. \$1960 per pair.

**Versitron**, 9005-8 Junction Dr, Annapolis Junction, MD 20701. Phone (301) 497-8600.

Circle No 361

### COOLING SWITCH

- Operates on logic-level inputs
- Can operate to 70°C

The Series 305 cooling-failure switch operates on 5V dc input signals and responds to any change in temperature in 1 to 3 sec. The switch can generate a false signal when its own temperature exceeds



a factory preset limit. Operating over a 5 to 70°C range, the switch features a self-heated glass-bead thermister, which compensates for ambient temperature, air speed, altitude, and relative humidity, and can sense a reversal in air flow. The switch is cooled by the same air stream that cools the host equipment, and measures 3 x 0.5 in. From \$15.

**Cambridge Aeroflo Inc**, 900 Mt Laurel Circle, Shirley, MA 01464. Phone (508) 425-2346.

Circle No 362

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QUALITY NO. 1  
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#### ERK Series

- Switches at 200 KHz
- MAG-AMP Regulation
- AC 115/220V (selectable)
- 100, 150, 200W Triple and Quad
- Safety: UL, CSA, TUV
- EMI: FCC/VDE 0871 Class "B"

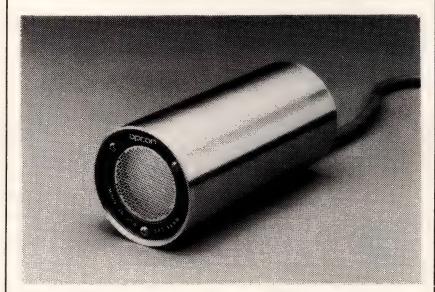
Volgen also features top quality custom services and standard unit modifications.

Uninterruptible Power Supply — check out our new model VPS-500V!



**Volgen America Inc.** 39650 Liberty Street, #325, Fremont, CA 94538  
(415) 498-5950 FAX (415) 498-5954

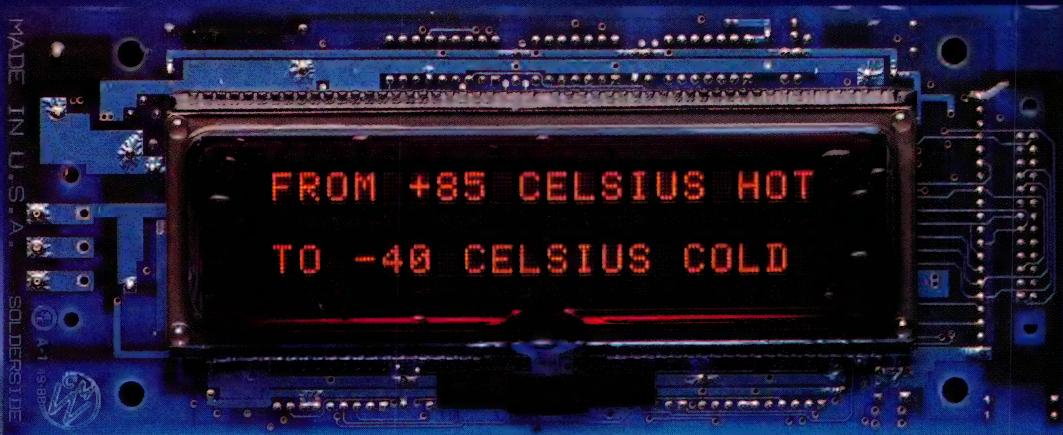
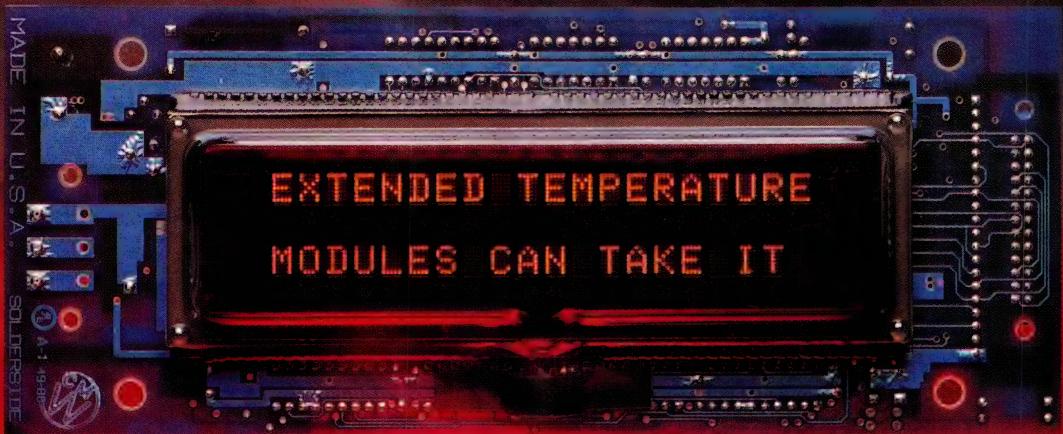
CIRCLE NO 38



### ULTRASONIC SENSORS

- Feature noncontact operation
- Withstand harsh environments

UC60 Series ultrasonic sensors offer a noncontact distance-sensing capability. The series is made up of the UC60-LN1A analog output-level sensor and the UC60-ZD1A switched-output zone-detection sensor. Both include adjustable sensing-zone features, built-in temperature compensation, short-circuit/transient-protected outputs, and 10 to 30V dc operation. The LN1A outputs distance measurements as an analog voltage or current. The ZD1A produces a switched output when an object enters a preset zone. Both units are built to with-



# THE VF MODULES TO USE IF HELL FREEZES OVER.

If that day arrives and you need a clear readout, DeeCO's XT and XTB extended temperature display modules won't let you down.

From  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , through 40g shock and 2g rms vibration, XT series modules can take the heat. And the cold. And whatever else you or the forces of evil throw at them.

And when you need clear sunlight readability, our XTB1x40 high brightness extended temperature module delivers more than 600 fL of brilliant performance.



XT and XTB features include selectable baud rates, 15 microsecond-per-character burst mode for high-speed display changes, steady or flashing characters, and brightness control.

If you'd like further proof of how well we go to extremes, we'd be happy to send you test results from an independent testing lab. For more information about XT and XTB extended modules, or our full line of VF and EL display products, write or call (415) 471-4700.

**DeeCO**

Digital Electronics Corporation, 31047 Genstar Road, Hayward, CA 94544-7831 (415) 471-4700. DeeCO is a registered trademark of Digital Electronics Corporation © 1989.

CIRCLE NO 37

## COMPONENTS & POWER SUPPLIES

stand harsh environments and are encapsulated in stainless-steel cases that carry a NEMA 1, 2, 12, and 13 rating. UC60-LN1A, \$695; UC60ZD1A, \$595.

**Opcon Inc.**, 720 80th St SW, Everett, WA 98203. Phone (206) 353-0900.

Circle No 363

### DC/DC CONVERTERS

- Provide 1.5W single- or split-rail outputs
- Have 500V input-to-output isolation

EL1 isolated dc/dc converters have an output power rating of 1.5W and are available in single- or dual-output versions. Single-output ver-



sions have an output voltage of 5, 12, or 15V, and dual-output versions have split-rail  $\pm 5$ ,  $\pm 12$ , or  $\pm 15$ V outputs. They are available with nominal input-voltage ratings of 5, 12 or 24V. Their input-to-output isolation voltage capability is 500V dc, and they have an isolation resistance of  $10\text{ G}\Omega$ . Line regulation is more than  $\pm 0.3\%$  for a  $\pm 10\%$  input voltage change, and zero- to full-load output regulation is more than  $\pm 0.5\%$ . All versions have a Pi filter on the input to minimize input and output noise. The converters are housed in standard DIP packages that measure  $32 \times 20 \times 10.5$  mm and weigh 17g. They have a  $-25$  to  $+71^\circ\text{C}$  operating temperature range. £18.

**Gresham Powerdyne Ltd**, Gresham House, Telford Rd, Salisbury, Wiltshire SP2 7PH, UK. Phone (0722) 413080. TLX 477576. FAX 0722-336263.

Circle No 364

**Dowty Electronics Corp**, Box 250, Prospect St, Brandon, VT 05733. Phone (802) 247-6811.

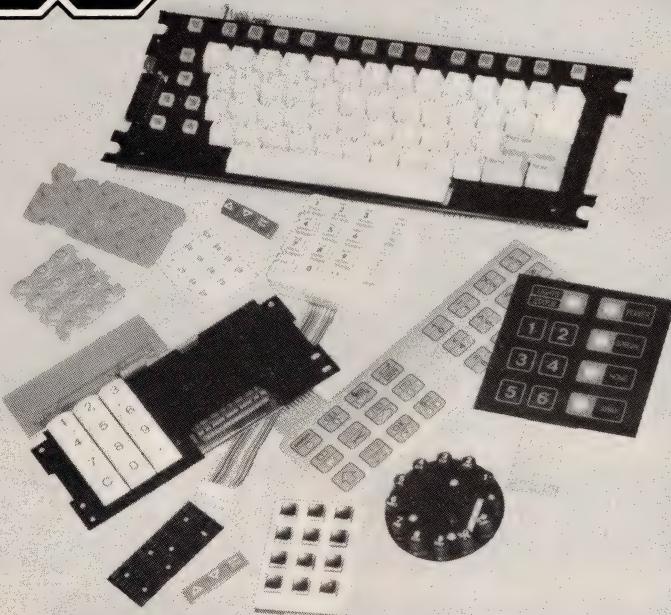
Circle No 365

### CONNECTORS

- Have 15 contacts in a 9-contact shell
  - Feature gold-plated contacts
- Sigma-D crimp-insertable D-subminiature connectors provide 15 contacts in a 9-contact shell. You can install the contacts by hand or with a machine. The brass contact pins and phosphor bronze sockets have gold over nickel plating as



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CIRCLE NO 36

## COMPONENTS & POWER SUPPLIES

standard. Other finishes are available as an option. The contacts have a 5A/500V dc rating. The connectors can accept #26 or 28 AWG wire sizes. Contacts are available in reels or in loose pieces for hand crimping. Male connectors, \$1.31 (500); 10,000-pin reel of contacts, \$70.

**Vernitron Corp.**, Beau Products Div, Box 10, Laconia, NH 03247. Phone (603) 524-5101. FAX 603-524-1627.

Circle No 366

### SELECTOR SWITCHES

- Available in top- or side-adjust versions
- Sealed to withstand assembly processes

SS-10 rotary DIP selector switches are available in top- or side-adjust versions. Single- and dual-pole models are available with four or six contacts and three contact configurations, respectively. All surfaces are permanently sealed to withstand standard soldering and washing processes. The self-cleaning, gold-plated contacts have a 5V/100 mA resistive switching rating. Contact resistance equals 100 mΩ max. The switches can carry 50V dc at 100 mA. The rotational life equals 500 cycles min and the operating range spans -10 to +60°C. \$1.70 (100).

**Mepcopal Co.**, 11468 Sorrento Valley Rd, San Diego, CA 92121. Phone (619) 453-0332. FAX 619-481-1123.

Circle No 367

### FAN SYSTEM

- Offers 12- and 15-fan capacity
- Design isolates vibration

The Airmatic 300 Fan Tray system features models with either a 12- or 15-fan capacity. The tray is configured from two structural foam halves, which include individual fan compartments to isolate noise and vibration. Rubber standoffs mounted to 8 points on the fan fur-

ther isolate noise and vibration. Each fan compartment is prewired, and each fan is terminated with a plug to ease fan replacement or additions in the field. Empty fan positions come with foam and a metal insert. All trays feature a brushed and anodized front panel, which includes easy-access handles. You can

order the trays with any number of fans from one to each tray's maximum capacity. 12-position tray with one fan, \$302.47.

**Dacobas Inc.**, 1890 N Voyager Ave, Simi Valley, CA 93063. Phone (805) 526-7733. FAX 805-584-8371.

Circle No 368

# Thoroughbred

**Mizar's SPARC CPU keeps you ahead from start to finish.**



You'll be favored to win with Mizar's MZ 7170, the VME processor with triple crown features. With the power of SPARC™ and the speed of zero wait-state SRAM, the MZ 7170 lets you run your application in record time. All for a price that keeps you on track.

The MZ 7170 was bred for demanding applications: a SPARC CPU at up to 25 MHz (15 MIPS), one MB of fast SRAM, up to four MB of EPROM, two RS-232 serial ports, mailbox interrupts, real-time clock, and optional TI. 8847 FPU. And, the MZ 7170 is supported by a complete real-time operating system and UNIX®-based development tools.

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# NEW PRODUCTS

## TEST & MEASUREMENT INSTRUMENTS

### CALCULATOR

- Performs 254 functions
- Works with simultaneous equations and complex numbers

The TI-68 advanced scientific calculator performs 254 functions and handles complex numbers as easily as it handles real ones. It can simultaneously display the real and imaginary parts of a complex quantity. The  $6 \times 3 \times 0.6$ -in. unit sports a 12-character alphanumeric LCD that scrolls horizontally to display equations having as many as 80 characters. The calculator can solve five simultaneous equations; a plain-English prompting scheme guides you through equation entry. You can recall and replay the last equation entered, and you can edit equations after you've entered them. The calculator allows you access to as many as 36 registers and lets you assign names to the registers. You can enter as many as 12 formulas; the formulas remain in memory even when the calculator is off. The unit also determines the real and complex roots of quadratic, cubic, and quartic equations. \$65.

**Texas Instruments Inc**, Box 53, Lubbock, TX 79408. Phone (806) 747-1882.

Circle No 380

### AUDIO TEST SET

- Generates 8-ppm distortion sine waves from 1 Hz to 102.39 kHz
- Provides 0.03%-inaccurate crystal-controlled frequencies

The 3100B generator and 3200B autoranging analyzer form an audio test set that measures amplitude

and phase vs frequency and intermodulation (IM) and total harmonic distortion (THD) vs frequency or amplitude. The analyzer measures phase from  $-180^\circ$  to  $+180^\circ$  with  $0.1^\circ$  resolution to 40 kHz and ac voltages from 4  $\mu$ V to 100V with residual THD and IM of 20 ppm. The generator stores 91 front-panel setups and can produce sine waves from 1 Hz to 102.39 kHz with 8-ppm distortion and square waves from 1 Hz to 50 kHz with a rise time of  $<1$   $\mu$ sec. As the frequency is crystal controlled, errors are less than 0.03% at fixed frequencies and on some sweeps. Generator, \$4250; analyzer, \$5495.

**Sound Technology**, 1400 Dell Ave, Campbell, CA 95008. Phone (408) 378-6540. TLX 357445.

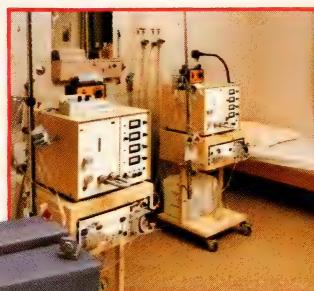
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*Text continued on pg 230*

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**SONNENSCHEIN BATTERIES, INC.**  
P.O. Box 339, Cheshire, CT 06410  
(203) 271-0091

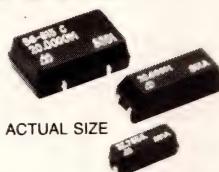
Exclusive Canadian Agent:  
**Advanced Battery Systems**  
Mississauga (416) 670-7159

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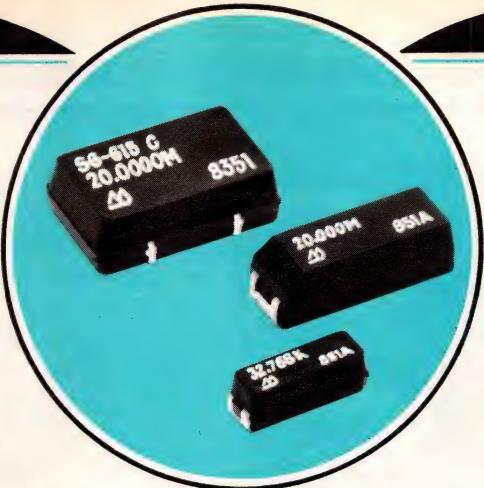
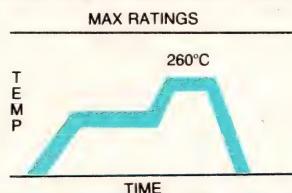
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Now, for the first time, you can surface mount crystals and CMOS crystal oscillators with complete confidence. That's because Epson has developed new materials that will withstand 260°C for 20 seconds (see curve), well above standard IR and Vapor Phase Reflow processing temperatures. And our CMOS oscillators give you high-speed 5 nsec rise and fall times, 45/55 symmetry (typ) and low power consumption.

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| CRYSTALS | CMOS CRYSTAL OSCILLATORS   |          |   |
|----------|--|----------|---|
| PART NO. | FREQUENCY  | PART NO. | FREQUENCY                                 |
| MC-405   | 32.768 KHz   | SG-615   | 1.5000 MHz ~ 25 MHz<br>(25 ~ 50 MHz) 1/89 |
| MA-505   | 12 MHz ~ 25 MHz<br>(4 MHz ~ 12 MHz) 9/88<br>(25 MHz ~ 60 MHz) 1/89 |          |   |

Call us for detailed information.

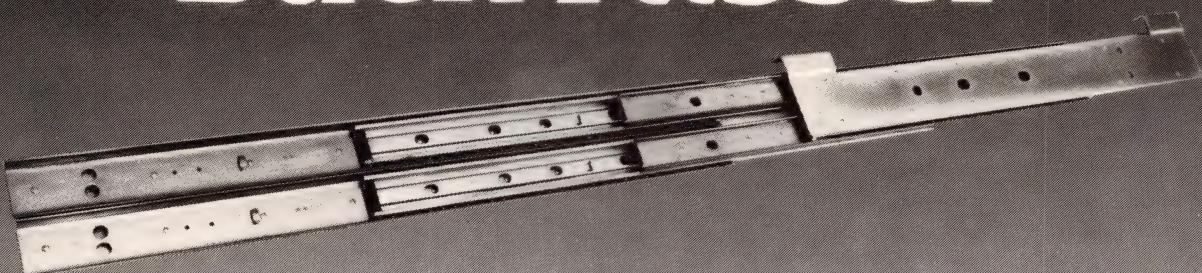
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EPSON AMERICA, INC. Component Sales Department  
3415 Kashwa St., Torrance, CA 90505

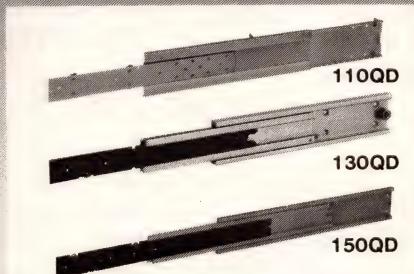
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CIRCLE NO 32

# "Buck Passer"



Manufacturers of Automatic Teller Machines have found they need a rugged, reliable slide mechanism for their cash dispenser — one that can stand up to the rigors of daily use and abuse. Jonathan has responded with a specially designed slide of exceptional strength, reliability and longevity. This steel, 4-section, ball-bearing tiered slide has a 140 lb. capacity, over its 34-inch extension. Built with a 4:1 safety factor, it has been tested to over 50,000 cycles, with outstops impacted and a 10 lb. side load applied. ■ If you have a problem involving chassis slides or other similar slide devices, talk to us at Jonathan — our Application Engineering Group probably has a reliable answer . . . at an economical price.



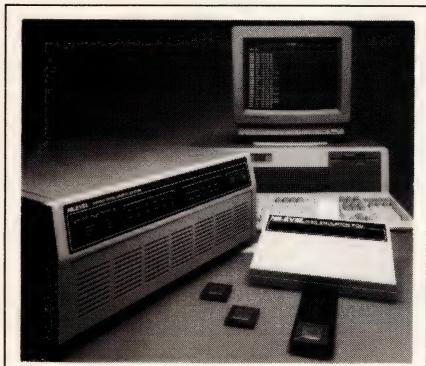
Jonathan's extensive lines of chassis slides are industry standards in industrial and aerospace applications — with load ratings to 800 lbs.



Jonathan Manufacturing Corporation • 1101 So. Acacia Ave., Fullerton, CA 92634 • (714) 526-4651 • FAX: 714-773-5582

See us at Electro/89 Booth No. 2009  
CIRCLE NO 31

## TEST & MEASUREMENT INSTRUMENTS



### RISC DEVELOPER

- Supports 88000 RISC chips
- Traces system activity in real time to 50 MHz

The DS5000 development system provides in-circuit support for the 88100 RISC processor and the 88200 cache/memory management unit. The development system can perform 256-channel logic analysis and provides 16 levels of unrestricted triggering. It traces all target-system activity in real time to 50 MHz and captures trace data in 4k- or 16k-frame buffers. You can define trigger conditions for the cache, program memory, data memory, instruction memory, or combinations of all of them. By using a pair of buffers and filling one while routing the other's contents via DMA to the host processor's RAM, the development system can acquire data continuously. The development system works with MS-DOS-based hosts, including some Sun Microsystems units. \$28,000 to \$40,000. Delivery, six weeks ARO.

**Hilevel Technology Inc.**, 31 Technology Dr., Irvine, CA 92718. Phone (800) 445-3835; in CA, (800) 541-2742. TLX 655316.

Circle No 382

### TEST TRANSLATOR

- Translates PLD test vectors
- Creates source files for GenRad testers

The JED2DTS software utility runs on DEC VAXs under VMS and on IBM PCs, PC/XTs, PC/ATs, and compatible computers. The utility

translates PLD test vectors created with the vendor's ATG (automatic test generator) software into DTS (digital test source) files for GenRad 227x and 2282 in-circuit pc-board test systems. The DTS files include head, inhibit, disable, force, and main sections. If the number of vectors exceeds a user-defined limit, the utility creates multiple pattern bursts. PLD definition files let you customize the translation process. \$1695 including communication software for error-free file transmission to the tester.

**Anvil Software Inc.**, 427-3 Amherst St., Suite 341, Nashua, NH 03063. Phone (603) 891-1995. FAX 603-891-1999.

Circle No 383



### DMM/THERMOMETER

- Offered with °C and °F readouts
- Measures ac current with clamp-on transformer

The ACA Series of multimeters includes three models, two of which measure temperature—one in °F, the other in °C. All three units incorporate a peak-hold function; the two that measure temperature also include data-hold and diode-check functions. All three models measure ac current via integral clamp-on

**For more information on ASC products call the Representative near you.**

### US and Canadian Representatives.

#### NORTHEAST:

|                         |  |
|-------------------------|--|
| BGR Associates          | (NJ) (609) 983-1020                        |
| EE & S, Inc.            | (MD) (301) 269-4234<br>(VA) (804) 794-8939 |
| F&F Metro               | (NY) (516) 482-4080                        |
| R.O. Whitesell & Assoc. | (PA) (412) 963-6161                        |
| Quality Components      | (NY) (315) 682-8885<br>(716) 837-5430      |

#### SOUTHEAST:

|                           |   |
|---------------------------|---|
| SACS                      | (FL) (407) 857-3650<br>(407) 391-1034<br>(813) 577-6819   |
| Design Marketing & Assoc. | (TX) (214) 480-8151<br>(504) 542-1115<br>(512) 263-9151<br>(713) 550-3318                                       |
| SACS                      | (NC) (919) 859-9970   |
| R.O. Whitesell & Assoc.   | (AL) (205) 883-5110<br>(GA) (404) 449-9190<br>(KY) (502) 241-1441<br>(TN) (615) 352-4760<br>(TN) (615) 694-9476 |

#### MIDWEST:

|                               |  |
|-------------------------------|--|
| Circuit Sales, Inc.           | (N. IL) (312) 773-0200<br>(W. IL) (414) 784-7773   |
| Comprehensive Technical Sales | (MN) (612) 941-7181  |
| Hill & Company                | (W. MO) (314) 432-1136<br>(Ks) (816) 561-2593  |
| C.H. Horn & Assoc.            | (IA) (319) 393-8703  |
| John Macke Co.                | (S. IL)(E. MO) (314) 432-2830  |
| R.O. Whitesell & Assoc.       | (OH) (216) 447-9020<br>(219) 432-5591<br>(MI) (313) 559-5454<br>(MI) (313) 695-0770<br>(IN) (317) 359-9283<br>(IN) (317) 457-9127<br>(OH) (513) 298-9546<br>(OH) (513) 521-2290<br>(OH) (614) 888-9396<br>(MI) (616) 942-5420<br>(MI) (616) 983-7337 |

#### WEST:

|                           |  |
|---------------------------|--|
| Compass Marketing & Sales | (NM) (505) 888-0800<br>(AZ) (602) 293-1220<br>(602) 996-0635 |
| J.S. Heaton Company       | (CA) (415) 367-9000  |
| N.R. Schultz Company      | (WA) (206) 454-0300<br>(OR) (503) 643-1644                   |
| Waughman Associates       | (CO) (303) 423-1020<br>(UT) (801) 261-0802                   |
| WCV/Raltech               | (CA) (818) 700-0933  |

#### CANADA:

|                          |                        |
|--------------------------|------------------------|
| Renmark Electronics Ltd. | (E. CD) (416) 881-8844 |
|--------------------------|------------------------|



CIRCLE NO 29

# BEST PERFORMANCE IN A SUPPORTING ROLE.

## ASC Presents First Class Film Capacitors And Technical Support, Second To None.



When you buy high technology film capacitors from ASC, you get all the support you need, absolutely free. It begins with a fully computerized sales and customer service department authorized to provide extremely competitive prices on volumes large and small. It means you get the highest level of technical support from a nationwide team of engineers prepared to help you with application specific solutions over-the-phone or at your own facility. And, when it comes to custom or "special orders," well, it's just standard procedure with us. All this, plus "just in time" deliveries that go out on time.

Since our acquisition of TRW's film capacitor division, ASC has acquired a reputation for service and support, second to none. By combining strong engineering know-how, and an even stronger commitment to technical

support, ASC has emerged as the fastest growing film capacitor manufacturer in the U.S.

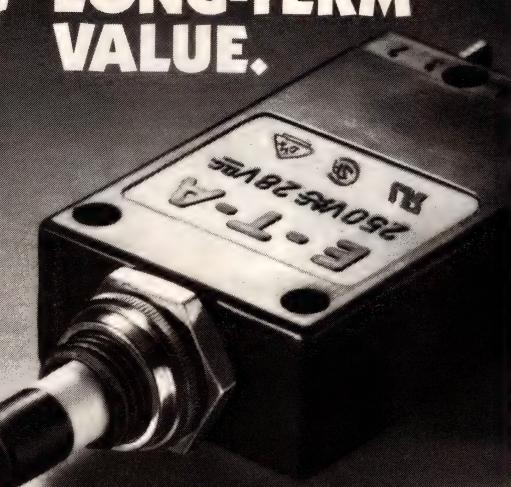
In fact, you'll find we offer one of the most complete lines of high quality, cost effective film capacitors in the world, including: polyester, polycarbonate, polypropylene and polystyrene dielectrics, both metallized and non-metallized, plus oil filled capacitors for lighting and motor run applications.

So, when you want an award winning performance in both product and personnel, call ASC. We'll show you why business is better when it's done right, at home. Call us today at **818/710-8555**.



Sales & Marketing, Canoga Park, California  
Engineering & Manufacturing, Ogallala, Nebraska  
ASC, 21541 Blythe Street, Canoga Park, CA 91304

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If your only concern is initial cost, then fuses cost less than E-T-A circuit breakers. But beyond initial cost, there's reality. Fuses blow and can drive up your cost of warranties, service, replacement, even product liability.

E-T-A circuit breakers, on the other hand, add value to your product. Yet they can lower costs while providing superior circuit protection and better performance characteristics than fuses. For example, they're trip-free, foolproof, 100% tested for quality, and approved for use, worldwide.

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CIRCLE NO 28

## DID YOU KNOW?

Half of all EDN's  
articles are staff-written.

## EDN

## INSTRUMENTS

transformers on full-scale ranges of 200 and 400A. The unit that doesn't measure temperature also includes a 20A ac current range. AC-current-measuring accuracy on all units is 1% to 100A. All units measure ac and dc voltage and resistance and have four dc-voltage ranges. The unit that doesn't measure temperature has four resistance and two ac-voltage ranges. The other units have two resistance ranges and one ac-voltage range. \$119; \$109 without temperature measurement.

**Extech Instruments Corp.**, 150 Bear Hill Rd, Waltham, MA 02154. Phone (617) 890-7440. TLX 940913.

Circle No 384

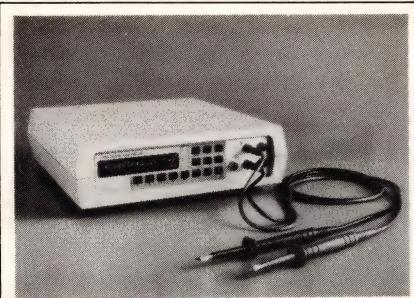
## BOARD TEST SOFTWARE

- Adds enhancements to 1800-Series testers
- Automatic test-program backup prevents program loss

A software update to the vendor's 1800-Series board testers incorporates five features that expand test coverage and increase programming flexibility. These features include dual threshold measurements, which let you define both high- and low-voltage regions; HiCheck, which produces a 4-digit hexadecimal signature for all high-region measurements; digital filtering, which increases stability in a voltage measurement by averaging multiple sample readings; HiGuard, which improves guarded measurement accuracy by eliminating the thermal EMF of relay contacts; and differential measurements, which let you make voltage measurements that aren't referenced to system ground. The addition of program flow control and branching capabilities increases programming flexibility. \$500.

**Zehntel Inc.**, 2625 Shadelands Dr, Walnut Creek, CA 94598. Phone (415) 932-6900. TWX 910-385-6300.

Circle No 385



### CABLE CUTTER

- Cuts round cables
- Handles 300-pair cable

The PA 1818 portable cable cutter is 12 in. long. It cuts round multi-conductor cables containing as many as 300 signal pairs. It also cuts copper cables to 750 MCM (thousands of circular mils) and alu-

minum cables to 1000 MCM. The unit includes a folding safety latch and a release mechanism that enables you to move the tool to a different location. \$239.

**Paladin Corp.**, 3543 Old Conejo Rd., Suite 102, Newbury Park, CA 91320. Phone (805) 499-0138.

**Circle No 388**

### DIGITAL MULTIMETERS

- Have a 1-year dc voltage accuracy of 20 ppm
- Include an IEEE-488 interface and digital recalibration

The Model 5001 and Model 6001 are 6½-digit instruments that have a 24-hour dc voltage stability of  $\pm(4$  ppm of reading + 2 ppm of full scale) and a 1-year dc voltage accuracy of  $\pm 20$  ppm. The Model 5001 provides dc and true-rms ac voltage, dc and true-rms ac current, and 2-wire resistance measurement functions. The Model 6001 has the same basic specification as the 5001, and also provides both temperature measurement using a 100- $\Omega$  platinum resistance thermometer probe, and 4-wire resistance measurement. Both instruments have dc voltage measurement ranges from 0.2 to 1000V, ac voltage measurement ranges from 2 to 700V rms, dc and ac current ranges of 2 mA and 2A, and resistance measurement ranges of 200 $\Omega$  to 12 M $\Omega$ . The instruments provide measurement periods selectable between 50 msec and 10 sec and feature math functions, an IEEE-488 interface, and digital recalibration facilities. A 10-channel input scanner option is available for both instruments. Model 5001, \$1495; Model 6001, \$1695.

**Prema GmbH**, Robert-Koch-Strasse 10, 6500 Mainz 42, West Germany. Phone (06131) 50620. TLX 4187666. FAX 06131-506222.

**Circle No 386**

**Prema Precision Electronics Inc.**, 4650 Arrow Highway, Suite E5, Montclair, CA 91763. Phone (714) 621-7292. FAX 714-625-2098.

**Circle No 387**

### ONE OF THESE CAN CHANGE THE WAY YOU SEE LIGHTING.



#### WE'D LIKE TO SEND YOU ONE OF OUR EL LAMPS—

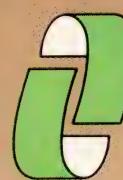
Bend and twist it. Bang it. Dunk it. Freeze it. And then watch it light up when you plug it in.

Only our electroluminescent (EL) lamps can take it. Because only our EL lamps combine solid-state technology with Loctite quality and reliability.

Besides standing-up to conditions that would virtually destroy incandescents and other ELs, our lamps also stand-out with useful life, exceeding 10,000 hours. With uniform surface illumination, so you can forget your balancing act. With no heat. With all kinds of sizes and shapes—in any color.

#### HERE'S HOW TO GET ONE, SO YOU CAN SEE FOR YOURSELF.

Just send this ad, along with your business card, to Mike Hartman, our Marketing Manager. Along with our DESIGN GUIDE, he'll send you a sample EL lamp—both free. After you kick it around for a while, you'll understand why we say—no other light can hold a candle to ours.



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**CIRCLE NO 25**

# NEW PRODUCTS

## CAE & SOFTWARE DEVELOPMENT TOOLS

### REAL-TIME KERNEL

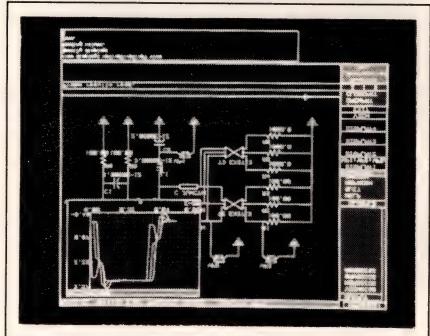
- Runs in the 32-bit, protected mode of the 80386
- Allows a combination of local and global tasks

MTOS-UX/386 is a multiprocessing, multitasking, real-time operating system for 80386-based computers. This OS normally runs in the 32-bit, protected mode of the 80386, and protects system resources such as block and memory pools, message buffers, controlled shared variables, and task resources. Also available is a version that uses the multisegmented memory model to run MS-DOS software. This model protects the kernel and the system resources by means of task privilege levels. You can increase the computing power of the system merely by adding up to 16 CPUs;

changing the number of CPUs does not require any change to the applications programs. The development kit includes test facilities, debugging tools, validation programs, configuration programs, a RAM-disk driver, a Unix interface, and a C-portable library. The symbolic debugger provides task-level debugging facilities. Because all versions of MTOS-UX have the same programmer interface, programs written in a high-level language will run under any version of MTOS-UX, regardless of the processor type. Development kit prices start at \$5000.

**Industrial Programming Inc.**,  
100 Jericho Quadrangle, Jericho,  
NY 11753. Phone (516) 938-6600.  
TLX 429808. FAX (516) 938-6609.

Circle No 389



### CAE TOOL

- Handles double-sided SMT designs
  - Handles multiple power planes and as many as 16 signal layers
- The MAXI/PC schematic-capture and pc-board layout package can execute double-sided, surface-mount designs with as many as 16 signal layers; it also handles multiple power and ground planes having

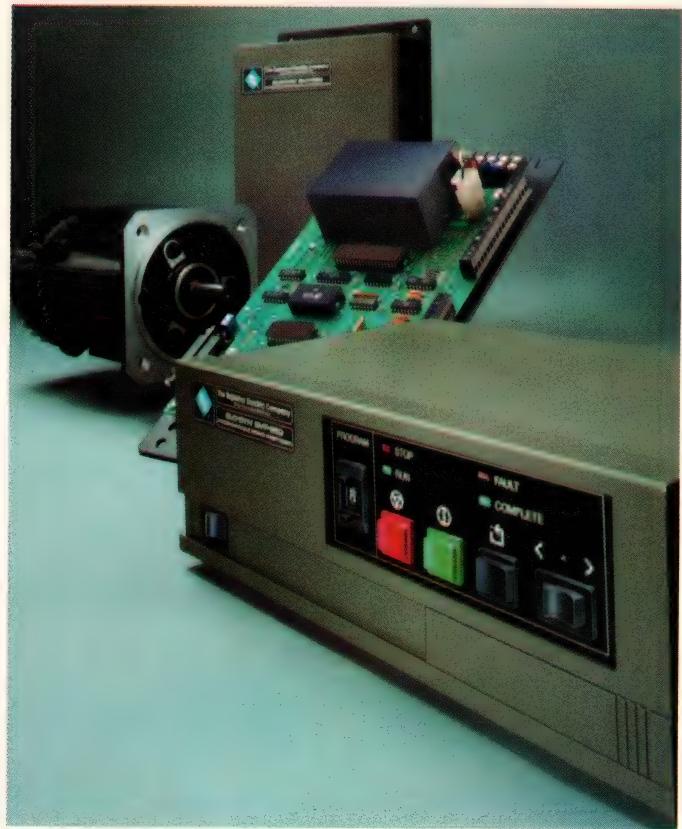
## New SLO-SYN® Servo Positioners

*... with real time adaptive gain control for constant, smooth, stable positioning of brush or brushless servos.*

The new 800 Series SLO-SYN® Closed Loop Servo Motion Controls are single axis, stand-alone positioners that can execute stored motion profiles with a velocity programming resolution of 8,000,000:1. They are ideally suited for industrial automation applications which require demanding precise control of positioning or velocity.

800 Series units can be programmed and directed through an RS232 serial port from PC compatible software, a "dumb" terminal or a hand-held programmer. For systems configured with discrete I/Os, they can be externally interfaced through 14 defined inputs and outputs. All controls feature *real time adaptive gain control* that automatically adjusts the gain to compensate for load changes. The high velocity programming resolution ratio permits speed changes in extremely small increments.

A complete file of SLO-SYN® Motion Control literature is available on request. It is must reading for anyone involved with motion control system design.



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**The Superior Electric Company**

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a resolution of  $\frac{1}{1000}$  in. High-speed automatic features include placement, gate- and pin-swapping, component renaming, back-annotation, and routing. The package runs on IBM PCs and compatibles. \$995.

**Racal-Redac Inc.**, 238 Littleton Rd., Westford, MA 01886. Phone (508) 692-4900.

Circle No 390

### STABILITY ANALYZER

- Simplifies setup and operation of a network analyzer
- Includes modeling and synthesis package for loop analysis

The S350/3577 stability software package allows you to integrate your HP3577A Network Analyzer from Hewlett-Packard (Palo Alto, CA) with an IBM PC or compatible, a printer, and a plotter, to form a complete stability-analysis workstation. The menu-driven software simplifies the setup and operation of the HP3577A, so that you can quickly obtain Bode plots or Nyquist diagrams of control-loop circuits. You can store the data on disk for later analysis and circuit optimization. The software includes the vendor's proprietary K-factor modeling and synthesis package for loop optimization; the software also works with PC-MATLAB for matrix computations, and with ECA-2 for circuit modeling and analysis. From \$5995.

**Venable Industries Inc.**, 3555 Lomita Blvd., Torrance, CA 90505. Phone (213) 539-2522. FAX 213-539-4139.

Circle No 391

### SIMULATION MODELS

- Library contains models for more than 4000 LSI/VLSI devices
- Models allow fault simulation at the board or system level

SmartModels is a library of behavioral models for more than 4000 LSI/VLSI devices. Previously available for logic simulation, the

vendor has now adapted all the models for use on Mentor Graphics' (Beaverton, OR) QuickFault fault simulator. The vendor plans to support other simulators that have a behavioral interface. Behavioral models are easier to write and faster to load than gate-level models; they also run faster and allow

you to simulate larger designs without increasing the memory requirements. SmartModels allow concurrent fault simulation; that is, you can divide the design into several parts and run each part on a different node of a network, or on parallel processors of a multiprocessor system. The original subscription serv-

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Our electroluminescent (EL) lamps give you light that's easy to work with.

Instead of juggling grains of wheat, we give you a single field of light, perfectly uniform and balanced the moment you plug it in.

Instead of bulk, we give you a lamp so thin, it's barely three-dimensional—lighted almost edge to edge. We can make our lamps in all kinds of sizes and shapes—with cutouts and holes to fit protruding knobs and switches.

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And with our lamps, we give you solid-state-of-the-art construction backed with our Loctite applications know-how. So for solutions to any problem, we're here. To learn more, send for our DESIGN GUIDE, the definitive reference on electroluminescence. Because the solution to your lighting problem may be as simple as seeing it in a new light.



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CIRCLE NO 24



ice to SmartModels for fault simulation costs \$7900; the FLEX-Node service, which allows you to move licenses around a network, costs \$9900 (minimum, 3 FLEX-Node subscriptions).

**Logic Automation**, 19500 NW Gibbs Dr., Beaverton, OR 97006. Phone (503) 690-6900.

Circle No 392

### C LIBRARY

- Lets you build resident shared libraries
- Allows you to convert existing programs to TSR versions

*/\*resident\_C\*/* is a library of C routines for building terminate-and-stay-resident (TSR) programs. The C routines let you build interrupt-service routines, such as timers that schedule a program to run at a particular time. You can also build resident shared libraries that can be accessed by any number of programs. The library also allows you to convert existing C programs to TSR status by adding a few function calls. Other routines included in the library let you save screens or windows so your TSR program won't disrupt the program that it interrupts. Versions of the library are available for the Microsoft (QuickC and C 5.0), Borland (Turbo C), and Lattice C compilers that run on IBM PCs and compatibles. The distribution disk includes demonstration programs that show you how to use the library and how to build shared libraries. Binary version, \$99; binary and source code, \$198.

**Essential Software Inc**, 76 S Orange Ave, Suite 3, S Orange, NJ 07079. Phone (201) 762-6965.

Circle No 393

### NET-LIST GENERATOR

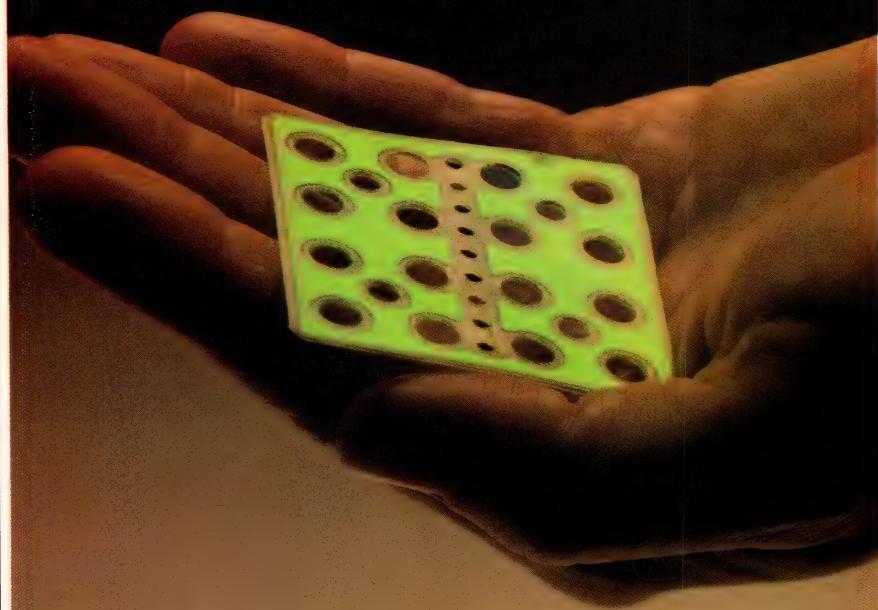
- Allows you to reverse-engineer pc boards
- Copes with boards that contain high pin-count devices

The Net-Learn utility software for

the company's SI635 diagnostic test system lets you reverse-engineer pc boards by generating a connectivity net list for the board's components. You can then use the net list to construct a schematic diagram. The menu-driven software uses the system's in-circuit test capabilities to learn the pin-to-pin interconnec-

tions between all the devices on the pc board. Net-Learn combines as many as 128 test channels to cope with high pin-count devices. The utility employs a 2-pass test strategy to generate the net list. During the first pass, the pc board under test is powered up, and the tester locates all pins that are connected

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When your product needs lighting that absolutely has to work—everytime, everywhere—you need our electro-luminescent (EL) lamps.

Because in lighting, there's nothing tougher or more reliable than our solid-state-of-the-art construction. Tough Aclar packaging makes our lamps durable. Special phosphors with our unique desiccant layer make them dependable. Our lamps will survive where lesser lights—both incandescent and EL—face sure and sudden death.

So, in vibration and shock, in temperature extremes, in humidity and moisture, our EL lamps really shine...on and on. In fact, their useful lives exceed 10,000 hours.

And we can provide this reliability in almost any color. In all kinds of sizes and shapes.

### SEND FOR OUR DESIGN GUIDE. IT'LL SHED MORE LIGHT.

When it comes to electroluminescence, we've quite literally written the book. And we'd like to send it to you—the DESIGN GUIDE. Because when you spend a lot of time making your product and your reputation solid, lighting shouldn't be its weakest link.



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CIRCLE NO 23

## CAE & SOFTWARE DEVELOPMENT TOOLS

to power or ground lines. The pc board is turned off during the second pass, and the utility determines the interconnections between devices. The system eliminates faulty net-list generation by checking for good probe contact before the learning process begins. To cope with board modifications or updates, the

software can perform a partial learn operation. You can use the output files from Net-Learn to generate schematic diagrams for the pc under test. Around £2100.

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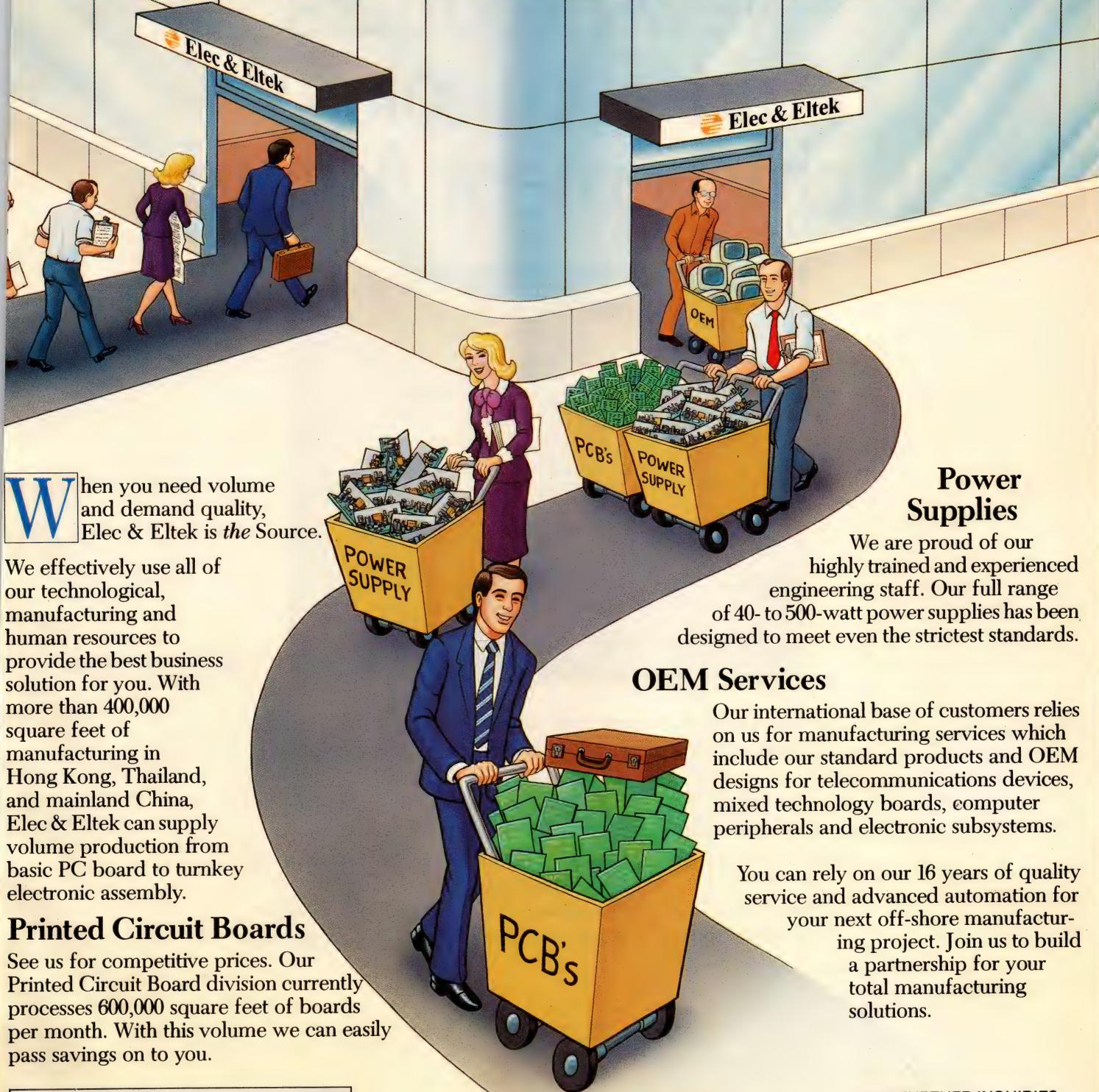
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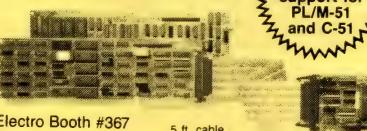
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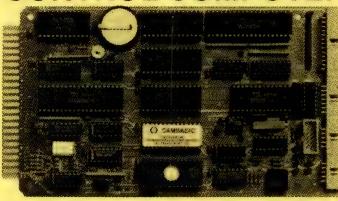
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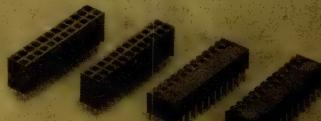


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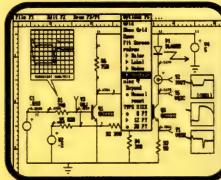
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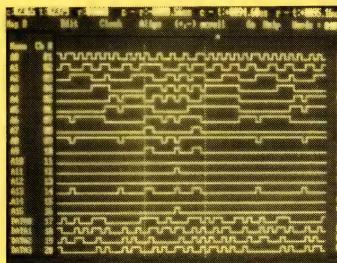
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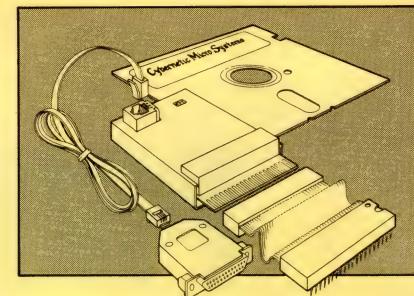
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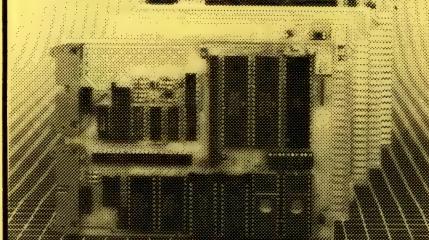
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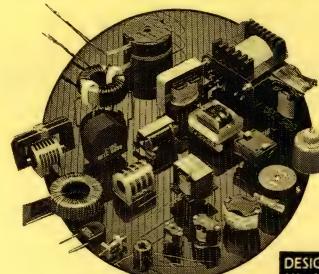
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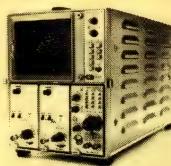
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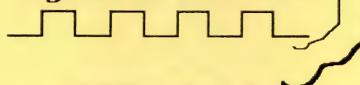
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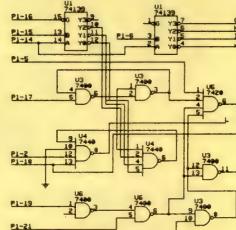


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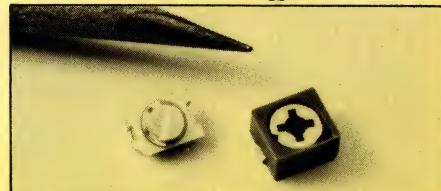
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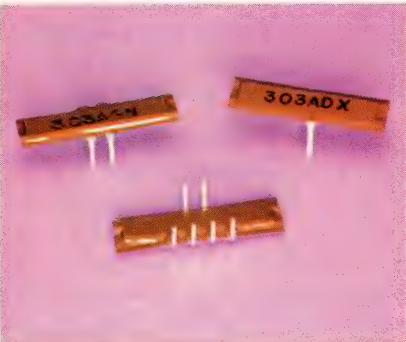
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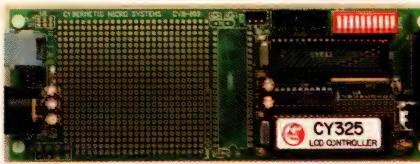


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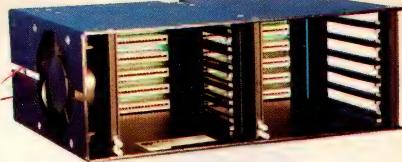
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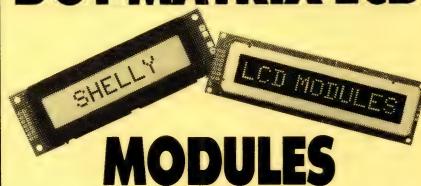
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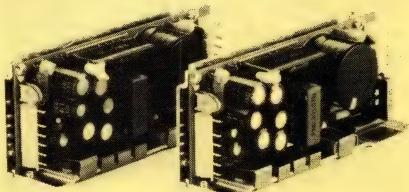
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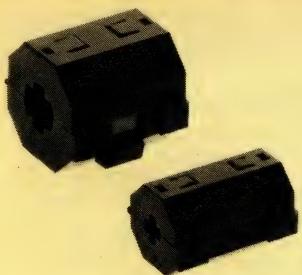


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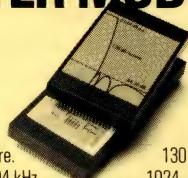
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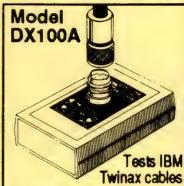
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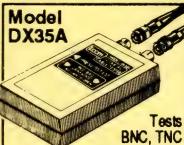


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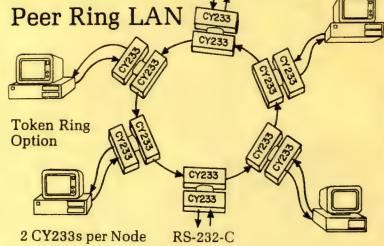
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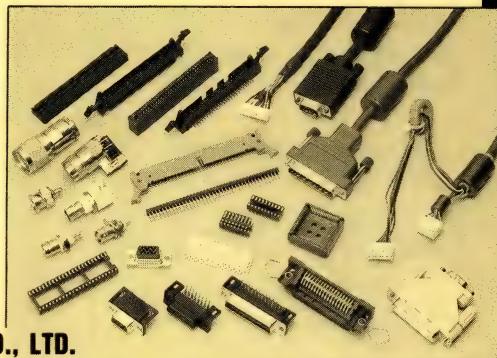
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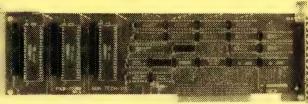
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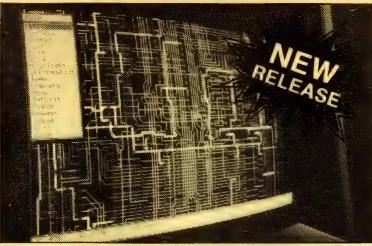
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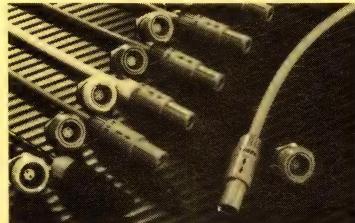
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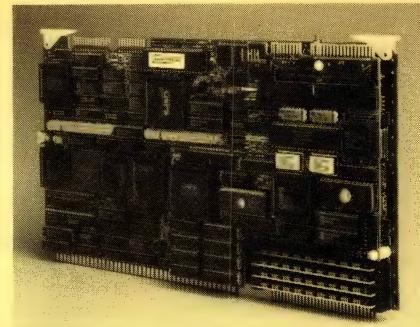
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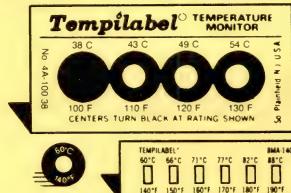
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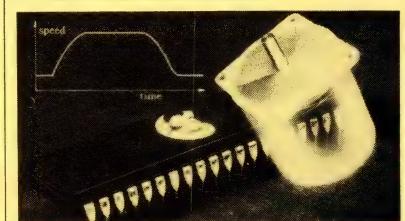
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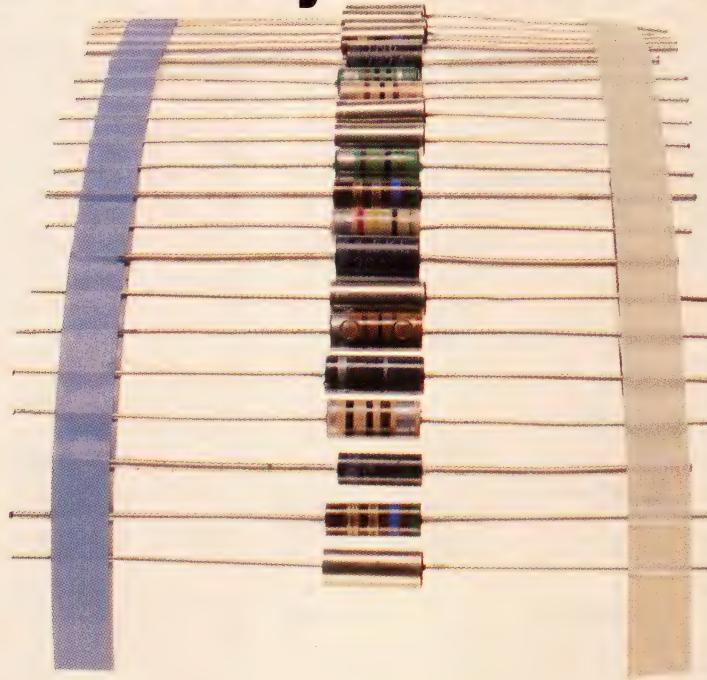


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| DATE                  | TIME                | SITE   | DATE                  | TIME                | SITE   |
|-----------------------|---------------------|--|-----------------------|---------------------|--|
| April 3<br>Monday     | 9:00-12:00<br>AM    | LOCKHEED ENGINEERING & SCIENCES COMPANY<br>2400 Nasa Rd., Houston, TX            | April 21<br>Friday    | 9:00-11:30<br>AM    | EMERSON ELECTRIC<br>Evans Ave., St. Louis, MO  |
| April 3<br>Monday     | 1:30-4:00<br>PM     | COMPAQ COMPUTER CORPORATION<br>20555 FM 149, Houston, TX                         | April 21<br>Friday    | 1:30-3:30<br>PM     | EMERSON ELECTRIC, Electronics & Space Div.<br>8100 W. Florissant, St. Louis, MO        |
| April 4<br>Tuesday    | 9:00-11:00<br>AM    | TEXAS INSTRUMENTS INC., Data Systems Group<br>12501 Research Blvd., Austin, TX   | April 24<br>Monday    | 9:00-11:00<br>AM    | MTS SYSTEM CORPORATION<br>14000 Technology Dr., Eden Prairie, MN                       |
| April 4<br>Tuesday    | 1:00-3:30<br>PM     | IBM CORPORATION<br>11400 Burnet Road, Austin, TX                                 | April 24<br>Monday    | 11:45-2:00<br>AM-PM | IMPRIMIS TECHNOLOGY INC.<br>5950 Clearwater Dr., Minnetonka, MN                        |
| April 5<br>Wednesday  | 8:30-11:00<br>AM    | TRACOR, INC.<br>6500 Tracor Lane, Austin, TX                                     | April 24<br>Monday    | 2:45-4:30<br>PM     | HONEYWELL, INC., Defense Systems<br>5901 So. County Road 18, Edina, MN                 |
| April 5<br>Wednesday  | 1:00-3:30<br>PM     | TEXAS INSTRUMENTS INC., Data Systems Group<br>5701 Airport Road, Temple, TX      | April 25<br>Tuesday   | 8:30-10:30<br>AM    | HONEYWELL, INC. Military Avionics<br>6300 Olson Memorial Pkwy., Golden Valley, MN      |
| April 6<br>Thursday   | 8:30-10:30<br>AM    | ROCKWELL INTERNATIONAL<br>1225 N. Alma Road, Richardson, TX                      | April 25<br>Tuesday   | 11:30-1:30<br>AM-PM | HONEYWELL, INC., Military Avionics<br>1625 Zarthan Avenue, St. Louis Park, MN          |
| April 6<br>Thursday   | 11:30-1:00<br>AM-PM | ROCKWELL INTERNATIONAL<br>Shiloh & Renner Road, Richardson, TX                   | April 25<br>Tuesday   | 2:30-4:30<br>PM     | IMPRIMIS TECHNOLOGY INC.<br>7801 Computer Dr., Bloomington, MN                         |
| April 6<br>Thursday   | 2:15-4:30<br>PM     | E-SYSTEMS, INC., Garland Division<br>1200 Jupiter Road, Garland, TX              | April 26<br>Wednesday | 8:30-11:00<br>AM    | CONTROL DATA CORPORATION<br>3101 East 80th St., Minneapolis, MN                        |
| April 7<br>Friday     | 8:30-11:00<br>AM    | ELECTROSPACE SYSTEMS INC.<br>Greenville Ave. & Terrace Dr., Richardson, TX       | April 26<br>Wednesday | 12:30-2:30<br>PM    | NCR COMTEN<br>2700 Snelling Ave., Roseville, MN  |
| April 7<br>Friday     | 1:30-3:30<br>PM     | E-SYSTEMS, INC.<br>Farm Road 1570, Greenville, TX                                | April 26<br>Wednesday | 3:00-4:30<br>PM     | UNISYS CORPORATION<br>2276 Highcrest Dr., Roseville, MN                                |
| April 10<br>Monday    | 9:00-11:30<br>AM    | TEXAS INSTRUMENTS, INC.<br>8505 Forest Lane, Dallas, TX                          | April 27<br>Thursday  | 8:30-11:00<br>AM    | UNISYS CORPORATION<br>3333 Pilot Knob Rd., St. Paul, MN                                |
| April 10<br>Monday    | 1:00-3:30<br>PM     | TEXAS INSTRUMENTS INC.<br>13500 North Central Expressway, Dallas, TX             | April 27<br>Thursday  | 1:00-4:00<br>PM     | IBM CORPORATION<br>Hwy. 52 & Northwest 37th St., Rochester, MN                         |
| April 11<br>Tuesday   | 9:00-11:00<br>AM    | LTV -Missiles & Electronics Group<br>1902 West Freeway, Grand Prairie, TX        | April 28<br>Friday    | 8:30-11:00<br>AM    | ALLEN-BRADLEY COMPANY<br>1201 So. 2nd St., Milwaukee, WI                               |
| April 11<br>Tuesday   | 2:00-4:00<br>PM     | RELIANCE COMM/TEC<br>2100 Reliance Pkwy., Bedford, TX                            | April 28<br>Friday    | 12:00-1:30<br>PM    | GENERAL ELECTRIC, Medical Systems<br>16800 W. Ryerson Rd., New Berlin, WI              |
| April 12<br>Wednesday | 9:00-12:00<br>AM    | GENERAL DYNAMICS<br>Grants Lane, Ft. Worth, TX                                   | April 28<br>Friday    | 2:30-4:30<br>PM     | GENERAL ELECTRIC, Medical Systems<br>3000 N. Grandview Blvd., Waukesha, WI             |
| April 12<br>Wednesday | 2:00-4:00<br>PM     | RECOGNITION EQUIPMENT INC.<br>2701 Grauwylde Rd., Irving, TX                     | May 1<br>Monday       | 9:00-11:30<br>AM    | ROCKWELL INTERNATIONAL, Collins Avionics Div.<br>400 Collins Road NE, Cedar Rapids, IA |
| April 13<br>Thursday  | 8:30-11:00<br>AM    | TEXAS INSTRUMENTS INC. Data Systems Group<br>2501 S. Highway 121, Lewisville, TX | May 1<br>Monday       | 1:00-3:30<br>PM     | ROCKWELL INTERNATIONAL, Communications Div.<br>855 35th St. N.E., Cedar Rapids, IA     |
| April 13<br>Thursday  | 1:30-4:00<br>PM     | BOEING ELECTRONICS<br>7801 S. Stemmons, Corinth, TX                              | May 2<br>Tuesday      | 9:00-11:00<br>AM    | NORAND CORPORATION<br>550 Second St. S.E., Cedar Rapids, IA                            |
| April 14<br>Friday    | 9:00-11:30<br>AM    | TEXAS INSTRUMENTS INC.<br>6500 Chase Oaks Blvd., Plano, TX                       | May 2<br>Tuesday      | 1:00-3:00<br>PM     | LITTON INDUSTRIES, Clifton Precision<br>2734 Hickory Grove Rd., Davenport, IA          |
| April 14<br>Friday    | 1:00-3:00<br>PM     | TEXAS INSTRUMENTS INC.<br>2501 W. University, McKinney, TX                       | May 3<br>Wednesday    | 8:30-11:00<br>AM    | SUNDSTRAND CORPORATION, Data Control Group<br>4747 Harrison Ave., Rockford, IL         |
| April 17<br>Monday    | 9:00-11:00<br>AM    | IMPRIMIS TECHNOLOGY INC.<br>10323 West Reno Ave., Oklahoma City, OK              | May 3<br>Wednesday    | 1:30-3:30<br>PM     | MOTOROLA, INC.<br>1501 W. Shure Dr., Arlington Heights, IL                             |
| April 18<br>Tuesday   | 9:00-11:30<br>AM    | NCR CORPORATION<br>3718 N. Rock Rd., Wichita, KS                                 | May 4<br>Thursday     | 8:30-10:30<br>AM    | NORTHROP CORPORATION<br>600 Hicks Road, Rolling Meadows, IL                            |
| April 18<br>Tuesday   | 1:30-4:00<br>PM     | BOEING MILITARY AIRPLANE CO.<br>3801 South Oliver, Wichita, KS                   | May 4<br>Thursday     | 11:30-1:00<br>AM-PM | NORTHROP CORPORATION<br>2525 Buffe Road, Elk Grove Village, IL                         |
| April 19<br>Wednesday | 9:00-11:30<br>AM    | BENDIX KING<br>400 N. Rogers Road, Olathe, KS                                    | May 4<br>Thursday     | 2:00-4:00<br>PM     | MOTOROLA, INC.<br>1301 E. Algonquin Rd., Schaumburg, IL                                |
| April 19<br>Wednesday | 1:30-3:30<br>PM     | WILCOX ELECTRIC, INC.<br>2001 NE 46th St., Kansas City, MO                       | May 5<br>Friday       | 9:00-11:30<br>AM    | AG COMMUNICATION SYSTEMS<br>2500 N. Wolf Road, Northlake, IL                           |
| April 20<br>Thursday  | 9:00-12:00<br>AM    | AT&T BELL LABORATORIES<br>777 North Blue Pkwy., Lees Summit, MO                  | May 5<br>Friday       | 1:00-3:30<br>PM     | ZENITH ELECTRONIC SYSTEMS<br>1000 Milwaukee Ave., Glenview, IL                         |

# Now your CMOS backup battery can be what you've always wanted it to be.



## Just another component.

Forget those labor intensive methods normally required for printed circuit board mounting of batteries. Our new axial lead μPowerCells™ (Lithium Iodine 2.8V Solid CMOS Backup Cells) look like a resistor or capacitor. They're about the same size and they don't need special handling. You can put them on a sequenced tape reel for automatic printed circuit board insertion. And like most other components, μPowerCells™ can be wave soldered, cleaned and dried us-

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CIRCLE NO 18

# CAREER OPPORTUNITIES

## 1989 Editorial Calendar and Planning Guide



| Issue Date | Recruitment Deadline | Editorial Emphasis   | EDN News Edition                      |
|------------|----------------------|--|---------------------------------------|
| Apr. 27    | Apr. 6               | Communications Technology, Special Issue<br>Communication ICs  | Closing: Apr. 13<br>Mailing: May 4    |
| May 11     | Apr. 20              | Analog Technology, Special Issue<br>Computer Peripherals       | Closing: Apr. 28<br>Mailing: May 18   |
| May 25     | May 4                | Digital ICs, Computer Peripherals                              | Closing: May 25                       |
| June 8     | May 18               | Components, Digital ICs  | Mailing: June 15                      |
| June 22    | June 1               | Semicustom ICs,<br>Computer Boards                             | Closing: June 9<br>Mailing: June 29   |
| July 6     | June 15              | Product Showcase —<br>Volume I, Power Supplies                 | Closing: June 22<br>Mailing: July 13  |
| July 20    | June 29              | Product Showcase — Volume II, Components                       | Closing: July 21                      |
| Aug. 3     | July 13              | Integrated Circuits, Computer Boards                           | Mailing: Aug. 10                      |
| Aug. 17    | July 27              | Military Electronics, Special Issue<br>Military Software       | Closing: Aug. 4<br>Mailing: Aug. 24   |
| Sept. 1    | Aug. 10              | Test & Measurement,<br>Integrated Circuits                     | Closing: Aug. 18<br>Mailing: Sept. 7  |
| Sept. 14   | Aug. 24              | Industrial Product Showcase,<br>Digital ICs                    | Closing: Aug. 30<br>Mailing: Sept. 21 |
| Sept. 28   | Sept. 7              | Integrated Circuits,<br>Computer Peripherals                   | Closing: Sept. 15<br>Mailing: Oct. 5  |
| Oct. 12    | Sept. 21             | DSP Chip Directory,<br>Integrated Circuits                     | Closing: Sept. 28<br>Mailing: Oct. 19 |
| Oct. 26    | Oct. 5               | Test & Measurement, Special Issue, Computers & Peripherals     | Closing: Oct. 27                      |
| Nov. 9     | Oct. 19              | CAE, Integrated Circuits                                       | Mailing: Nov. 16                      |
| Nov. 23    | Nov. 2               | 16th Annual $\mu$ P/ $\mu$ C Directory,<br>Integrated Circuits | Closing: Nov. 9<br>Mailing: Nov. 30   |
| Dec. 7     | Nov. 16              | Product Showcase — Volume I,<br>Power Supplies                 | Closing: Nov. 22<br>Mailing: Dec. 14  |
| Dec. 21    | Nov. 30              | Product Showcase —<br>Volume II, Components                    |                                       |

Call today for information:

East Coast: Janet O. Penn (201) 228-8610  
West Coast: Mary Beth West (213) 820-3887  
National: Roberta Renard (201) 228-8602

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## When you put your best into your products, it shows.

At Compaq, the value of our products is simply a reflection of the personal values inherent in each Compaq professional. Attributes like teamwork, mutual respect, leadership and a commitment to quality translate into some of the most advanced personal computers on the market.

Our continued success has created immediate opportunities for top Engineering professionals at our Houston headquarters. Start with a degree and relevant experience. Add to that a strong set of personal values and the desire to do what's never been done before, and you could be part of a winning team.

### Microprocessor Logic and ASIC Design Engineers

Challenge your expertise in logic design and/or microprocessor system design using flow charts and timing diagrams for digital design and detailed design analysis. Your experience should include vendor libraries, test vector generation, simulation checkout and TTL emulators for gate array standard cell design. Familiarity with CAE

systems used in logic design, test vector generation, simulation checkout and documentation is also necessary. You must have five years' related experience plus a BSEE or equivalent degree. An MSEE degree is preferred.

### Systems Architects

You'll design new products by investigating and evaluating system compatibility and performance of design alternatives and new technologies. You'll develop hardware compatibility tests and performance analysis tools.

Qualify with a BSEE, MSEE preferred, and three years' hardware background with a knowledge of microprocessor-based systems software. In addition, experience with CPUs/Memory/Bus architecture, numeric co-processors, file subsystems, network communications, graphic subsystems and state machines is required.

### Systems Software Engineers

You'll evaluate, design and develop firmware, operating systems, device drivers and utility software for PC systems. Along with your BSEE/BSCS, you'll need four years' related experience in PC software development, 8086/286/386 Assembly/C language programming in MS-DOS,

OS/2 and/or UNIX/XENIX operating system environments.

### Software Engineers—Audit/Test

Put your design and development talents to the test improving structural software. You'll help increase the reliability of personal computer systems and operating systems software. Five years' software quality assurance or test development experience should complement your BSEE/BSCS. Experience in 'C' and 8086/286/386 Assembly language is essential.

### Make a quality career decision.

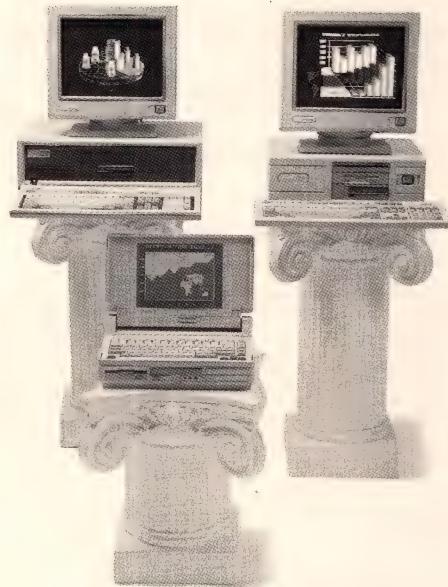
Compaq offers competitive salaries, comprehensive benefits and an unequalled work environment. If you're interested in one of these positions, please call us at 1-800-243-9003. Or simply submit your resume and the position for which you wish to be considered to: **Compaq Computer Corporation, Dept. EDN327-MW, P.O. Box 692000, Houston, Texas 77269-2000.**

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Since the nation's first space communications adventure nearly 30 years ago, GE Astro-Space has been a world leader in the design and manufacture of satellites for government and commercial communications, meteorological, navigational and scientific use.

And, with over one hundred and fifty satellites currently circling the globe—and long-term, history-making projects such as the *Mars Observer*, *Space Station* and *Landsat*—we can offer Engineers the kind of rare opportunities that few are destined to realize.

If you're the Engineer we're seeking, join us as we pave the way for a new generation of emerging space technology. Our mission requires the technical proficiency of Engineers with a minimum of 3 years experience in one or more of the following:

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- Antenna Design
- RF Packaging Design
- Robotics/Mechanism Design
- Spacecraft Attitude Control

## ■ Electrical Engineers/ Hardware

- Electronic Packaging
- Harness Design
- ATE/AGE Design
- Power Supply/Analog Design
- Video Design

## ■ Systems Engineers

- Spacecraft Power Systems
- Mission Analysis

## ■ Integration & Test Engineers

Our New Jersey location offers all the advantages of nearby Princeton—within easy access to New York City and Philadelphia. Additionally, selected positions are open in Valley Forge, PA. In either location, you'll experience a lifestyle that complements your career, providing unlimited opportunities for personal and professional growth. As the largest employer of engineers and scientists in the world, GE provides competitive salaries and exceptional benefits including tuition refund and continuing education programs—so your expertise is always current and expanding.

Rush your resume to: Employee Relations, Dept. EDNM, GE Astro-Space, P.O. Box 800, Princeton, New Jersey 08543-0800. An equal opportunity employer.

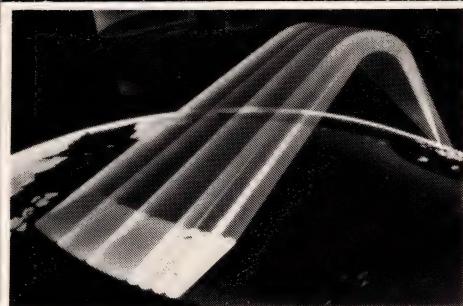


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**We make engineers like you part of the longest-term, most inherently dramatic "hide and seek" missions of our time.**

GE Government Electronic Systems Division is prime contractor for a second generation, integrated system that will make Seawolf SSN subs effective defenders well into the 21st Century.

If your ambitions include developing big, fast signal processing capabilities and linkages to advanced ASW sensor systems and C+...or being part of more powerful, more discriminating radar, sonar and acoustical programs that enlarge ocean surveillance capabilities of surface ships...tell GE.

The more that company resources and reputation mean to you—and the more you want to accomplish in system and software architecture, hardware and circuit design, low frequency and broadband sonar, and signal and data processing—the sooner we should meet. Do what our customers do. Talk to key GE managers at our two locations.

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### Systems Engineers/Managers

opportunities exist in:

- Algorithm Development   • Signal Processing   • Human Factors
- Sensor System Design   • Systems Analysis   • ASW Systems
- Combat Systems Architecture   • Reliability/Maintainability
- PIDS Through B level Specification Design

### Hardware/Circuit Design Engineers/Managers

help design the future by working in:

- CMOS   • Power Design   • Gate Array Design
- Configuration Management   • Cabinet Design

### Software Engineers/Programmers/Managers

opportunity to advance if you're experienced with:

- Top Down Structured Design   • MIL-STD 2167
- ADA Language Architecture and Programming
- Embedded Programmable Processors (68000 or similar)

### Software Quality Assurance Engineers

with experience in:

- Metrics/Trend Analysis   • ADA/Case tools helpful
- Strong organization/personal skills   • MIL-STD 2167/2168
- Summarizing detailed data for management decisions

### Choice opportunities also exist in the following areas:

- Advanced engineering design/development of future ASW systems
- Test and integration testing
- Quality assurance programs engineering
- Subcontracts management and financial analysis
- Field programs engineering (Naval systems)

Both locations provide competitive salaries, and the technical and management training and comprehensive benefits you'd expect from GE. To apply, please send your resume indicating position of interest, and salary history, to:

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U.S. Citizenship Required



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# Sun Microsystems invites you to take CIM to its limits. Then, go beyond them.

You might not expect a high technology company to put such an emphasis on CIM. But Sun Microsystems sees CIM as nothing less than a strategic advantage in the very competitive workstation market.

Sun already boasts shop floor control and automated handling and distribution, as well as complex board and system testing and decision-making support. Now we want to integrate our systems into one, functional architecture.

## Our goal: the ultimate CIM system.

This architecture will combine the ease of our user interface, vivid graphics, and networking capabilities with object-oriented programming in UNIX™ and "C," and distributed RDBMS to create the ultimate CIM system.

Sun has the resources to make it happen as one of the fastest-growing companies in America, with over one billion dollars in sales last year. We have a remarkable number of CIM experts in-house. More important, we have the explicit commitment and support of top management to make Sun unsurpassed at CIM.

But we need more. More people skilled in CIM to help us accomplish our ambitious goals.

## Here's your challenge.

Join the Sun Microsystems CIM effort, and you'll have the opportunity to work on any one of several challenges:

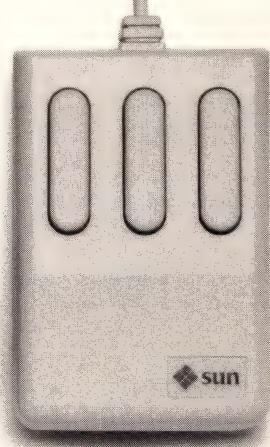
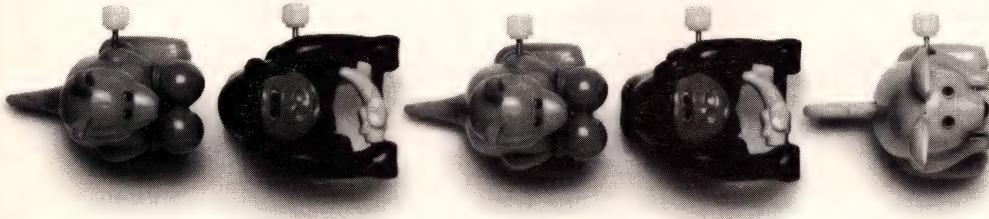
- Tools & Technologies Development
- Applications Software Development
- Systems Integration
- Engineering Services
- User Support Services

Experience in UNIX or "C" is essential to qualify for these positions. Candidates should also have manufacturing systems integration experience.

If you meet those spec's, apply now. Here are four of our current openings:

## System Administrator

You will provide system administrative support to the UNIX end-user community. This will include installing and maintaining all file servers, timeshare machines, laser printers, and networks, while working with third-party vendor software. Requires a BSCS/Information Systems and 1+ years' UNIX systems administration experience. Strong communication skills and an excellent working knowledge of UNIX and UNIX utilities, software documentation, shell programming, and networking are also needed.



## Software Development Engineers

Requires experience in CIM, systems integration and application software development for state-of-the-art software systems engineering in a UNIX environment. Additionally, you will need 3+ years' experience with UNIX and "C" as well as 3 years' CIM experience.

## Engineers — Surface Mount Technology

Develop, maintain, support and improve Pick & Place, paste, printing and re-flow processes for internal surface mount production line. Requires a BSME and 2-5 years' related experience in SMT process development. Panasonic and/or Fuji experience desired.

## Sr. CIM Systems Software Engineers

We have several positions available for individuals with experience in process control applications including factory automation and/or distribution, as well as statistical analysis in a manufacturing environment. Requires 3 years' experience as a group leader and experience with structured analysis and design techniques in an application design environment. Strong user interface and excellent communication skills required. Systems integration background and 3+ years' UNIX and "C" experience are preferred. For some positions, 4+ years' experience with relational database required.

To apply, please send your resume in confidence to Professional Employment, Sun Microsystems, Inc., M/S DAQ, 2550 Garcia Avenue, Mountain View, CA 94043. Letter-quality resumes will get to our hiring managers faster, since all resumes are electronically scanned and processed by the Resumix™ system. An equal opportunity employer. Principals only, please.

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T H E O P E N C H A L L E N G E

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  - Dell System 200, our largest-selling 286 system
  - Dell System 220, the most powerful 80286-based PC available
  - Dell System 310, the fastest PC based on the Intel 80386 20 MHz microprocessor
  - Dell System 325, our 25 MHz "no compromise" PC for high-level computing
  - A wide range of peripherals, printers, accessories and software
- Dell UNIX System V/386 was recently announced for the 386-based hardware
- International subsidiaries in the United Kingdom, Canada, Germany and Japan
- Largest Austin-based publicly-held corporation, with over 1,000 employees
- Dell is located amid the beautiful hill country and lakes surrounding Austin, TX. Austin offers an affordable quality of life, unsurpassed by most major metropolitan areas

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and  
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### LOGIC/VLSI DESIGN ENGINEERS

Challenging responsibilities include specification, development, implementation and testing of board level and/or chip level logic design for PC applications. Requires recent high-speed logic board/card design experience, preferably with I/O BUS and CPU complex focus. BS/MS EE.

### UNIX DESIGNERS

Software designers participate in team development of UNIX enhancements and customizations for Dell hardware. Five years total software design experience with two years in UNIX and C required. MS-DOS and Intel hardware and software experience preferred. Graphics and networking experience a plus. BS/MS EE.

### BIOS/DIAGNOSTIC PROGRAMMERS

Software group develops low-level Intel programs in support of hardware design projects. A solid understanding of hardware design with experience in BIOS or diagnostics, assembler and C programming required. BS/MS EE or CS.

### PROJECT PLANNERS

Responsible for product/project development from inception to market introduction. Requires experience in coordinating all aspects of project including design, procurement, support and administration as well as hardware/software assimilation. Prefer recent experience in PC project management with current knowledge of microprocessor-based industry. Minimum four year technical degree required.

### ADVANCED TECHNOLOGY ENGINEERS

Senior Engineers work independently in researching leading edge technologies for potential products. Position requires broad-based design/project management experience with thorough knowledge of high-speed microprocessor industry. BS/MS EE.

### ADDITIONAL OPPORTUNITIES

R & D groups listed below have positions requiring knowledge/experience with MS-DOS based PC hardware and software, assembler, C and UNIX.

- Systems Validation
- Systems Integration
- Mechanical Design
- Technical Publications

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9505 Arboretum Boulevard, Austin, Texas 78759  
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from



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|-------|--------------|---------------------|----------|----------|--------------------|---------------------|----------|-----------------|-------|
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| MAR-2 | DC-2000      | 13                  | 12.5     | 11       | 8.5                | +3                  | 6.5      | 1.50            | (25)  |
| MAR-3 | DC-2000      | 13                  | 12.5     | 10.5     | 8.0                | +8 <sup>□</sup>     | 6.0      | 1.70            | (25)  |
| MAR-4 | DC-1000      | 8.2                 | 8.0      | —        | 7.0                | +11                 | 7.0      | 1.90            | (25)  |
| MAR-6 | DC-2000      | 20                  | 16       | 11       | 9                  | 0                   | 2.8      | 1.29            | (25)  |
| MAR-7 | DC-2000      | 13.5                | 12.5     | 10.5     | 8.5                | +3                  | 5.0      | 1.90            | (25)  |
| MAR-8 | DC-1000      | 33                  | 23       | —        | 19                 | +10                 | 3.5      | 2.20            | (25)  |

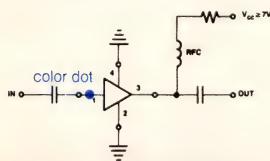
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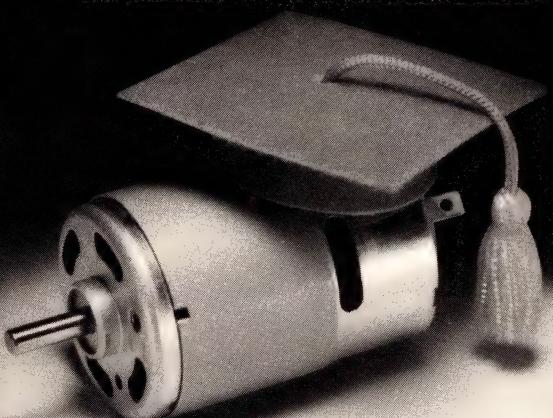
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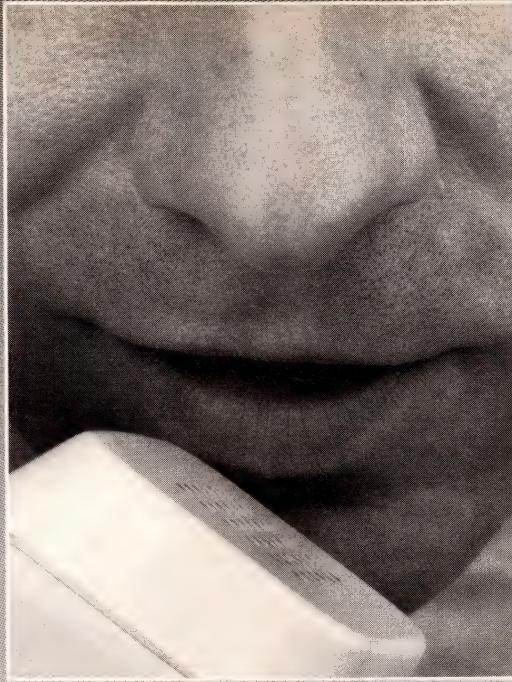
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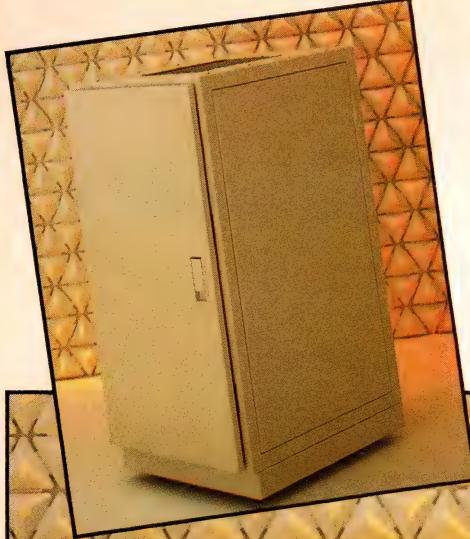
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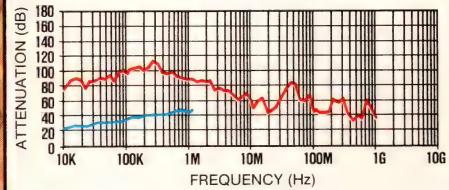
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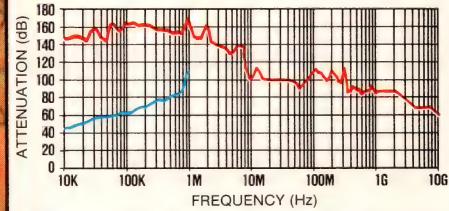
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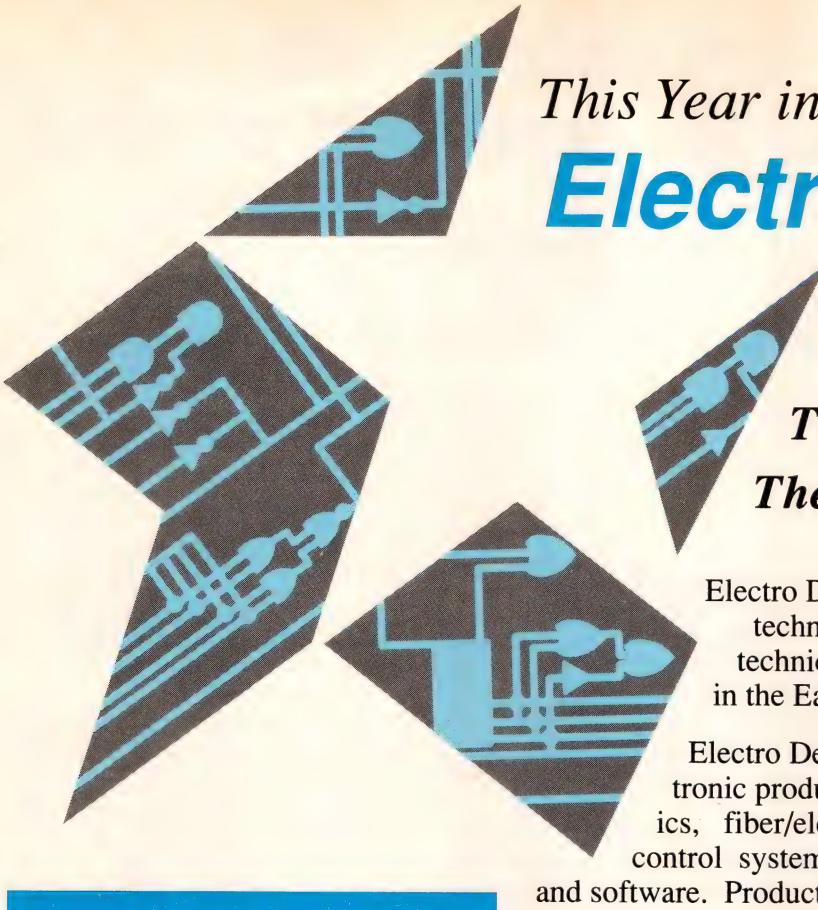
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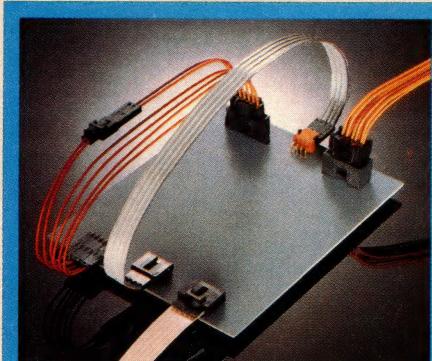
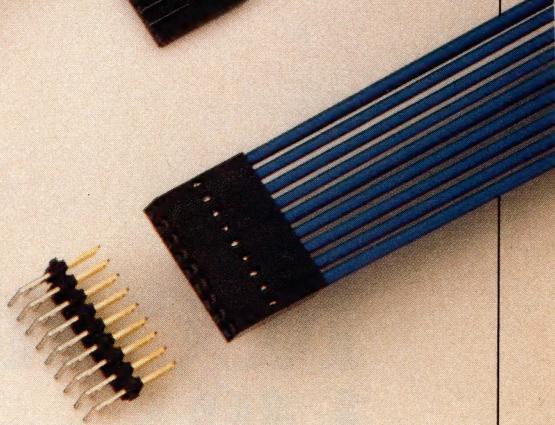
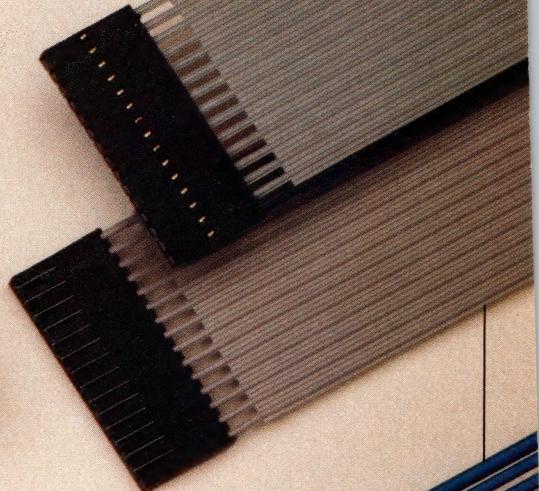
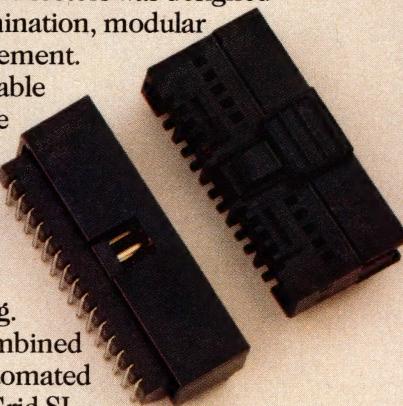
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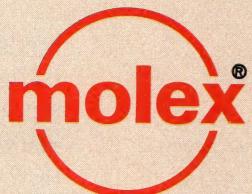
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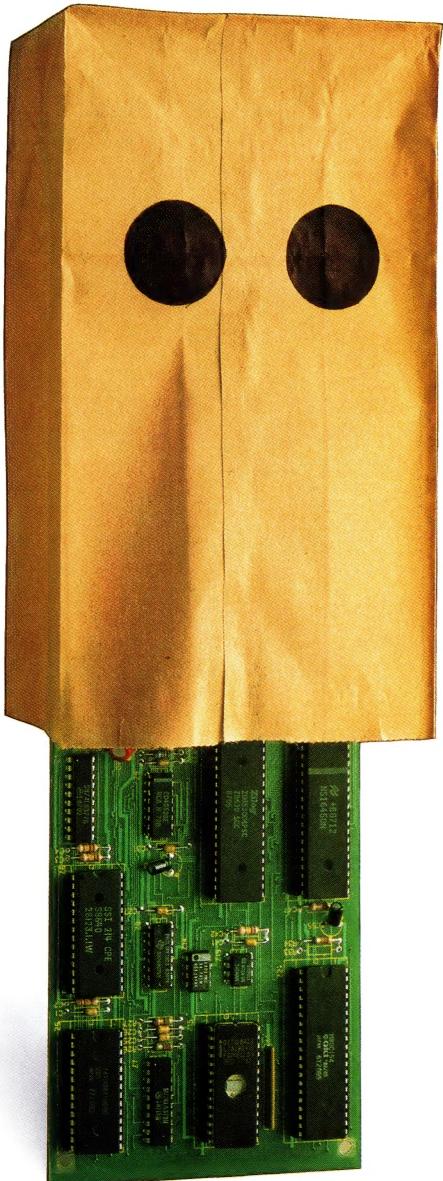
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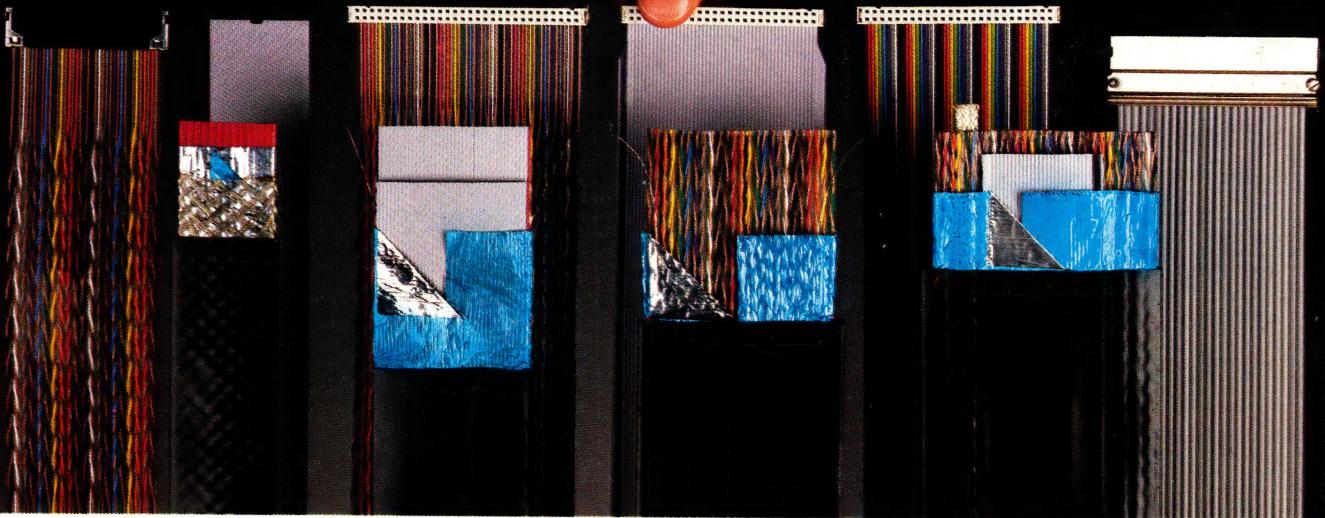
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Belden offers one of the most comprehensive flat cable product lines. Shielded or unshielded, twisted or straight, jacketed or unjacketed, PVC or FEP Teflon\*—all Belden® flat

\*DuPont trademark

cable is made to the same uncompromising level of quality.

Flat cable and connectors from Belden: we're helping you elimi-

nate traditional design conflicts with innovative solutions. That's why *There is no equal*. For more information on Belden Flat Cable and Connectors, request our Master Catalog 885. Belden Wire and Cable, P.O. Box 1980, Richmond, IN 47375.



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CIRCLE NO 10



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